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THIRD REPORT

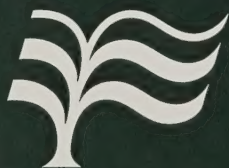
National Steering Committee for  
Application of Pesticides -  
Gypsy Moth and Other Eastern Defoliators

February 11, 1991

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- A. Committee Members and Addresses
- B. State and Committee Member Reports
- C. List of Tank Mixes and Atomizers Evaluated in Wind Tunnel



## I. INTRODUCTION

The meeting was held at the Hilton Inn, Salt Lake City, Utah, on November 7, 1990.

### A. Committee Members

J. Robert Bridges	WO/FIDR (Washington, DC)
Leo Cadogen	FPMI (Sault Ste. Marie, Ontario)
Tony Chiotakis	North Carolina Department of Agriculture (Raleigh, NC)
John Cunningham	FPMI (Sault Ste. Marie, Ontario)
Harold Flake	R-8/FPM (Atlanta, GA)
Michelle Frank	NA/FPM (Durham, NH)
Don Henry*	California Department of Food & Agriculture (Sacramento, CA)
Win McLane	USDA/APHIS (Otis AFB, MA)
Mike McManus	NE/FIDR (Hamden, CT)
Steve Munson	R-4/FPM (Ogden, UT)
Max Ollieu	R-6/FPM (Portland, OR))
Dick Reardon	NA/FPM/AIPM (Morgantown, WV)
Barry Towers*	PA Bureau of Forestry (Middletown, PA)
Harry O. Yates III	SE/FIDR (Athens, GA)
Jack Barry (Chairperson)	WO/FPM (Davis, CA)

Asterisk (\*) indicated committee members who were not at the meeting. Resignations from the committee were Alice Jones and Dan Twardus. New members are J. Robert Bridges and Harry O. Yates. William Buzzard, Pennsylvania, substituted for Barry Towers. Addresses and telephone numbers of committee members are provided in Appendix A.

Others attending the meeting included: Tom Hofacker, Pat Shea, Julie Weatherby, John Neisess, Gary Daterman, Jesus Cota, Iral Ragenovich, and Temple Bowen.



State and individual committee member reports delivered at the meeting and included in Appendix B are as follows:

1. **Leo Cadogen** - A Report to the USFS Joint Meeting of the National Steering Committee for Application of Pesticides - Western Defoliators, Gypsy Moth, and Eastern Defoliators.
2. **John Cunningham** - Application of Disparvirus Against Gypsy Moth in Ontario in 1990.
3. **Tony Chiotakis** - North Carolina Gypsy Moth Program 1990 Operations Summary.
4. **Jessie Rios** (For Don Henry) - California Gypsy Moth Program 1990.
5. **Michelle Frank** - 1990 Green Mountain National Forest Gypsy Moth Suppression Project; and State of Vermont 1990 Cooperative Gypsy Moth Spray Project Defoliation Assessments.
6. **Win McLane** - Report of Laboratory and Field Pesticide Testing Activities - APHIS - S&T.
7. **Steve Munson** - Utah Gypsy Moth Eradication Program 1990 Gypsy Moth Report.
8. **Ladd Livingston** - State of Idaho Summary Report of 1990 Gypsy Moth Eradication and Survey Efforts.
9. **Oregon** - Gypsy Moth Survey and Detection Programs - 1990.
10. **Colorado** - Colorado gypsy moth activities untitled report.
11. **Washington** - 1990 Gypsy Moth Program Summary Report.
12. **Pennsylvania** - Pennsylvania Gypsy Moth Suppression Project 1990.
13. **Dick Reardon** - Summary of AIPM Activities - 1990; and Status of Gypsy Moth NPV, Gypchek, in USA.

B. Purpose of Committee

The purpose of the committee is to review, identify, and recommend needs for field tests, pilot projects, and demonstrations of aerial application of pesticides. Needs include those associated with pesticides, application systems, techniques, and strategies that influence the USDA Forest Service's and State cooperator's ability to use pesticides safely, effectively, and in an economically, and environmentally acceptable manner.



### C. Operating Guidelines

The committee expanded its scope to include use of ground application of pesticides to manage gypsy moth and other eastern defoliators. The committee will also serve, at the request of the Director, Forest Pest Management, as a panel to review national technology project proposals that relate to gypsy moth and other eastern defoliators. Proposals for 1992 will be reviewed during the next committee meeting.

## II. CURRENT RECOMMENDATIONS

Current recommendations include new recommendations and certain recommendations carried over.

### A. Laboratory and/or Investigations

1. Investigate canopy architecture of eastern deciduous forests (shape, sub-canopies, density, leaf-area index, etc.) for input and enhancement of FSCBG aerial spray model.

High - Mike McManus

2. Investigate enzyme link immunosorbant assay (ELISA) or other techniques for rapid on-site determination of tank mix potency.

High - Pat Shea

3. Develop priority list of wind tunnel tests needed for undiluted formulations of Bacillus thuringiensis (B.t.) is determined by State/Federal cooperators. Conduct physical property/wind tunnel tests for priorities 1-10.

High - Dick Reardon

4. Investigate feasibility of using virus to manage pine sawfly.

Medium - Michelle Frank

5. Investigate use and timing of granular verticillium to control pear thrip.

Medium - Michelle Frank

6. Screen tank mixes for effects on automobile paint surfaces.

Low - Win McLane



## B. Field Tests

1. Conduct field tests of lower doses and lower volume of Dimilin.

High  
Priority 5 - Win McLane

2. Evaluate utility of FSCBG aerial spray model to predict canopy penetration model by comparing deposition predictions to observed prediction in eastern deciduous canopies.

High - NEFAAT

3. Evaluate canopy penetration and spray drift of B.t. spray applied to control gypsy moth in western deciduous forests and compare field results to model predictions.

High - Jack Barry  
Ken Bentson

4. Conduct B.t. efficacy tests and develop guidelines for using hydraulic sprayers to control gypsy moth.

Medium - NA  
R-8

## C. Demonstrations

Demonstrate utility of the gypsy moth phenology computer-base model supported by Omni-Data weather monitoring system to predict application timing.

High - Steve Munson

## D. Equipment, Models, and Technology Development

1. Investigate and demonstrate weather monitoring systems to support gypsy moth control projects and plan for personnel training in use of the systems.

High - Harold Flake

2. Evaluate capability of FSCBG aerial spray model to predict penetration of a B.t. spray into an oak canopy in Western U.S.

High - Jack Barry  
Bruce Grim

3. Review aircraft guidance and treatment block marking methods and publish a report that outlines equipment, methods, and advantages and disadvantages of each method.

High - MTDC



4. Conduct airport trails to verify randomly selected AGDISP swath width predictions reported in 1990 FPM Report Swath Width Evaluation. Make AGDISP model runs for additional aircraft.

Low - Harold Flake  
Dan Twardus  
Dick Reardon

E. Administrative

1. Pesticide tank mix recommendations for 1991 gypsy moth suppression programs are as follows:

<u>Product</u>	<u>BIU/Acre</u>	<u>Volume/Acre</u>	<u>Undiluted</u>
Thuricide 32LV	16	96 - 128 oz.	NO
Thuricide 48LV	16 to 30	"	16 to 30 BIU
SAN 415 (NRD-12)	"	"	"
Dipel 6AF	"	"	"
Dipel 8AF	"	"	"
Foray 48B	"	"	"

<u>Product</u>	<u>AI/Acre</u>	<u>Volume/Acre</u>	<u>Undiluted</u>
Dimilin 25W	0.03 lbs.	96 or 128 oz.	NO

Footnotes:

For diluted B.t. applications apply at 96 or 128 oz./acre.

Undiluted applications should be no less than 40 oz. of B.t. per acre.

For eradication use 2 or more applications of B.t. 5 to 7 days apart.

Stickers can be added to B.t. formulations if added protection is needed. Use 2% by volume or Bond, Plyac or NuFilm 17. Do not use Bond with Foray.

2. Conduct a workshop to develop standard spray aircraft contracting guidelines and specifications for aerial spraying in the East.

High - Dan Twardus  
Harold Flake

3. Maintain contact with EPA to encourage more flexibility on registration of minor use and environmentally acceptable pesticides.

High - WO/FPM

4. Establish a gypsy moth pheromone ad hoc committee composed of FS, APHIS, industry, state, and university representatives.

Medium - WO/FPM



5. Continue to encourage development of working relationship amongst Canadian and U.S. investigators who are pursuing gypsy moth research.

High - WO/FPM  
WO/FIDR  
NA/AIPM

6. Determine if there is a problem as expressed by members of the committee that poor pilot skill and low quality of application is contributing to poor control of gypsy moth. If there is a problem it might involve one or more factors to include contract specifications, unrealistic expectations, poor communications, inadequate quality control and monitoring, weather, treatment timing, untrained contract supervisors, etc.

High - Dan Twardus

7. Support applied research on monitoring gypsy moth populations and on timing of treatment.

High - WO/FIDR  
WO/FPM

### III. COMMENTS FROM STATE COOPERATORS:

On November 9, 1990 the committee met jointly with APHIS and State Cooperators to brief the group on recommendations of the National Steering Committee. We also solicited comments from the group and received the following:

- A. Need information on how much buffer is needed around areas treated with pesticides using ground sprayers.
- B. Need an ad hoc groups to deal with gypsy moth issues related to NEPA endangered species and other related issues.
- C. Need an agreement amongst public agencies on the issue of carriers in pesticides used for gypsy moth control. The public wants to know what they are and they want safety data information. This is an issue that the ad hoc group could address.
- D. Need research on gypsy moth eradication strategies in the West using viruses on low populations.
- E. Need to test phenology model and adapt to the West as host types differ.



#### IV. STATUS OF PREVIOUS RECOMMENDATIONS

Status of 1989 committee recommendations is summarized below.

##### A. Laboratory

1. Investigate relationship of drop size to drop number, potency and efficacy to control gypsy moth.

High - NEFATT

Study completed by John Bryant and Bill Yendol and data available from Mike McManus.

2. Investigate impact of B.t. and Dimilin on non-target organisms through conduct of literature searches, contacts with Forest Pest Management Institute (FPMI), and field studies.

High - Mike McManus  
Dick Reardon

Study in progress with report anticipated in 2 years.

3. Develop a plan to characterize B.t. and Dimilin tank mixes for physical properties, atomization, and evaporation.

High - Jack Barry

Wind tunnel tests have been conducted at University of California for FORAY 48B, Thuricide, SAN 415, and Dipel 6 and 8L, and data reported in FPM (Davis) Report 90-9 (Table of Contents enclosed as Appendix C). Compendium of Drop Size Spectra Compiled from Wind Tunnel Tests. Dimilin is basically water thus wind tunnel test are not needed. Wind tunnel data are needed for Dipel 6AF and Dipel 8AF. Gary Melchior has been contacted about this need. Bob Ekblad is contracting for evaporation studies; funding however is not available at MTDC or FPM (Davis) to conduct evaporation studies of all tank mixes of interest to gypsy moth managers. Technology project funding has been approved by WO to develop a model that predicts atomization based upon physical properties of the tank mix.

4. Develop a plan to obtain spreadfactors for tank mixes used to control gypsy moth.

High - Jack Barry

The U.S. Army, Aberdeen Proving Ground, was contracted to evaluate B.t. spreadfactors on deposit papers. FPM (Davis) Report 90-8, Spectroscopically Derived Spreadfactors for Different Bacillus thuringiensis Insecticidal Formulations on Paper Impaction Cards. The report discusses utility of kromekote



as an impaction surface and provides spreadfactors for Foray 48B and Thuricide 32 LV. Additionally Alam Sundaram and Errol Caldwell (FPMI) have been contacted about doing spreadfactors work for the FS. The latter is still under discussion. The pesticide laboratory at Pennsylvania State University determines spreadfactors for microbials and should be contacted for spreadfactor information. Recommend that industry be encouraged to provide spreadfactors for their products using standardized methodology.

5. Investigate canopy architecture of eastern deciduous forests (shape, sub-canopies, density, leaf-area index, etc.) for input and enhancement of FSCBG aerial spray model.

High - Mike McManus

Dave Miller, University of Connecticut, was contracted to begin this work. Data was reported at the Winnipeg, Canada Symposium on aircraft use in forestry, Oct. 1990. Proposals have been submitted by Dave to expand this work in 1991.

6. Evaluate carriers for Gypchek.

High - Mike McManus  
Dick Reardon

Evaluate the Ready To Use (RTU) in the UC Davis wind tunnel during February 1991. Cooperate with FPMI in evaluating other carriers.

7. Develop a process leading to the commercial production of Gypchek.

High - FPM/WO

WO has developed a technology transfer agreement with ESPRO, Inc. for commercial production of Gypchek. This is being coordinated closely with AIPM and NE Station.

8. Investigate the "Henderson" carrier as a suitable, and physically and biologically acceptable carrier for Gypchek and B.t. formulations.

Medium - Win McLane

No advantages observed and Abbott Labs reportedly is not interested in this carrier.

9. Screen tank mixes for effects on automobile paint surfaces.

Low - Win McLane

No work on this. Primary interest is the effects of undiluted materials especially those with oil carriers.



10. Investigate enzyme link immunosorbant assay (ELISA) or other techniques for rapid on-site determination of tank mix potency.

High - Pat Shea

Contact has been made with Bruce Hammock, University of California. He will supply antibodies and might have a graduate student available to develop the process for the FS, Pat Shea also will coordinate with Somu Sundaram, FPMI.

#### B. Field Tests

1. Conduct field test(s) to compare insect efficacy resulting from applications with rotary and hydraulic atomizers using operational tank mixes of B.t.

High  
Priority 1 - NEFATT

Test completed and report in preparation.

2. Conduct field test of Foray 48B comparing efficacy of 12 BIU applied 96 ounces per acre to 36 BIU applied 96 ounces per acre.

High  
Priority 2 - Mike McManus

Field test completed in 1989 and results reported.

3. Conduct field test of Gypchek comparing efficacy of standard dose to two lower doses.

High  
Priority 3 - Mike McManus

Field test completed and report in preparation.

4. Conduct field test to compare efficacy of an operational tank mix of B.t. tank mix containing the "Henderson" carrier.

High  
Priority 4 - Win McLane

No difference observed in field test.

5. Conduct field tests of lower doses and lower volumes of Dimilin.

High  
Priority 5 - Win McLane

Field test of 16 oz/acre completed and plan to test lower dosage.



### C. Demonstration Projects

1. Demonstrate control strategy of using Gypchek against small (50-75 acre) isolated infestations of gypsy moth.

High - Win McLane

Successfully demonstrated in North Carolina and West Virginia. Reports are pending.

2. Evaluate capability of FSCBG aerial spray model to predict penetration of a B.t. spray into an oak canopy in Western U.S.

High - Jack Barry

Study was conducted by Bruce Grim and Jim Rafferty, U.S. Army, 1990 in conjunction with the R-4 gypsy moth project. Data are being analyzed and report due September 1991. Plan to continue field study in 1991.

3. Demonstrate utility of the gypsy moth phenology computer - bases model supported by Omni-Data weather monitoring system to predict application timing.

High - Steve Munson

Some work has been done but more data is needed. Study will continue in 1991.

### D. Pilot Projects

1. Conduct a pilot project to test Foray 48B, 30 BIU, applied undiluted to determine if the application can consistently reduce gypsy moth populations.

High  
Priority 1 - AIPM

Pilot project completed and report is pending.

2. Conduct a pilot project to test efficacy under operational conditions Dipel 8AF, 30 BIU, applied undiluted.

High  
Priority 2 - AIPM

Pilot project completed and report is pending.

### E. Equipment, Models, and Technology Development



1. Investigate both ground and aerial application equipment systems and methods to control hemlock woolly adelgid.

High - Michelle Frank

Not done and interest in this insect is waning.

2. Investigate and demonstrate weather monitoring systems to support gypsy moth control projects and plan for personnel training in use of the systems.

High - Harold Flake

Equipment has been purchased and some limited operational use. Need to design and conduct a test in cooperation with a State to demonstrate the operational utility and application of the weather monitoring system; and to develop a strategy for its use.

3. Evaluate utility of FSCBG aerial spray model to predict canopy penetration model by comparing deposition predictions to observed prediction in eastern deciduous canopies.

High - NEFATT

One study has been completed and preliminary results reported. More work are planned in 1991.

4. Review aircraft guidance and treatment block marking methods and publish a report that outlines equipment, methods, and advantages and disadvantages of each method.

High - MTDC

State Cooperators expressed strong interest in this subject. Director, WO/FPM has requested MTDC to develop a proposal on how to obtain this needed information. A proposal is in preparation.

#### F. Administrative

1. Concurred with recommendation of the western defoliator steering committee to meet jointly in 1990. Harold Flake and Steve Munson agreed to host the meeting to be held in Salt Lake City, UT, November 6-8, 1990.

Meeting was held in Salt Lake City as recommended and reported herein.

2. Recommend research and development of guidelines on timing of pesticide treatments to control gypsy moth.

Dick Reardon will coordinate this activity.



3. Recommend that the Dan Twardus gypsy moth monitoring data-base be made available annually to State Cooperators and to this committee.

Report has been published and is available from Dan Twardus at Morgantown, West Virginia (304) 291-4133.

4. Recommend development and conduct of an east-wide pesticide-use training workshop annually for control of eastern defoliators.

NEFAAT has sponsored one workshop and has scheduled another.

5. Recommended tank mixes for 1990 suppression.

This list will be updated annually by the B.t. gypsy moth ad hoc committee. Need recommendations from Win McLane.

## V. Summary

The National Steering Committee for Application of Pesticides - Gypsy Moth and Other Eastern Defoliators met in Salt Lake City, Utah, November 7, 1990. The committee reviewed previous committee recommendations and noted numerous field projects have been completed; however reports are not available on the majority. New recommendations were developed and listed with previous recommendations that have not been addressed. The committee decided to include ground application of pesticides to its scope of activities. The committee will review 1992 FPM technology development project proposals for WO/FPM at its next meeting in June or July 1991.

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STATE AND COMMITTEE MEMBER REPORTS







A Report to the USFS Joint Meeting of the National Steering Committee  
for Application of Pesticides - Western Defoliations<sup>ORS</sup>, Gypsy Moth and Other  
Eastern Defoliations.

Salt Lake City, Utah 6th - 8th November 1990

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## Application of Disparvirus against gypsy moth in Ontario in 1990.

J.C. Cunningham, W.J. Kaupp, G.G. Grant, K.W. Brown,  
M.B.E. Cunningham, P. Ebling and D. Frech.

### Summary

Following successful Disparvirus trials in 1989 with a double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha) in an emitted volume of 5.0 L/ha, a reduced emitted volume of 2.5 L/ha was tested in 1990 using the same dosage as in 1989 and this was compared to 5.0 L/ha. The aqueous tank mix for both treatments contained 25% v/v molasses, 10% w/v Orzan LS, as a sunscreensing agent, and 2% v/v Rhoplex B60A sticker. A Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers was used for the 2 applications, 5 days apart, on mainly first instar larvae. Each treatment was applied on three plots about 10 ha in area and a further 3 plots were selected as checks. Pre-spray gypsy moth egg mass densities ranged from 2280 to 8900/ha in the 6 treated plots and from 2390 to 6690/ha in the 3 check plots.

In addition to defoliation estimates and egg mass counts, pupal counts in burlap traps and counts of male moths in pheromone traps were used in the assessment of the treatments. The criteria for a successful treatment on gypsy moth is defoliation of oak not exceeding 40% and post-spray egg mass densities below 1200/ha. In the 2.5 L/ha treatment, one plot had 46% defoliation, and two plots had post-spray egg mass densities above 1200/ha. Population reductions due to treatment (Abbott's formula) were 73, 82 and 90%. In the 5.0 L/ha treatment, defoliation ranged from 29 to 38% compared to 77 to 93% in the check plots. The plot with the highest pre-spray egg mass density of 8900/ha had a post-spray density of 1620/ha which was above the 1200/ha threshold; the other two were below the threshold. Population reductions due to treatment of 87, 91 and 95% were calculated for the 5.0 L/ha treatment. The 2.5 L/ha emitted volume was considered to be only marginally effective and 5.0 L/ha remains the recommended volume for application of Disparvirus using an aqueous tank mix.

### Introduction

Aerial spray trials were conducted in Lindsay District in 1988 when a double application of Disparvirus using  $1.25 \times 10^{12}$  PIB/ha (total  $2.5 \times 10^{12}$  PIB/ha) in an emitted volume of 10.0 L/ha gave excellent control when applied on mainly first instar larvae. It requires about 1,000 gypsy moth larvae to produce this dosage and both the dosage and emitted volume were considered to be too high for operational use. In 1989, trials were again conducted in Lindsay District. The dosage was reduced to a double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha) and emitted volumes of 5.0 and 10.0 L/ha were tested. The aqueous tank mix contained 25% v/v molasses, 10% w/v Orzan LS and 2% v/v Rhoplex B60A sticker. Applied on first and second instar larvae, the 5.0 L/ha application was as good as the 10.0 L/ha and the lower dosage gave satisfactory results. Hence, the recommendation for Disparvirus application was revised accordingly.

An emitted volume of 5.0 L/ha is still higher than volumes used for *Bacillus thuringiensis* applications which are usually less than 2.0 L/ha. It was therefore decided to test Disparvirus in the aqueous tank mix at a double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha) in 2.5 L/ha and compare this to the same dosage in 5.0 L/ha.

#### Experimental plots and spray application

Six treatment plots, each about 10 ha in area, and three check plots were selected in an area of recent gypsy moth infestation in Simcoe District. Plots were all west of the town of Simcoe and within 25 km of the town. The same dosage was applied on all 6 plots. It was a double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha). Two different emitted volumes, 5.0 L/ha and 2.5 L/ha, were tested. The tank mix contained 25% v/v molasses, 10% w/v Orzan LS, a lignosulphonate used as a UV protectant, and 2% v/v Rhoplex B60A sticker. The first spray application was on May 14th and the second, 5 days later, on May 19th. The FPMI Cessna Ag-truck fitted with 4 Micronair AU 4000 rotary atomizers was used for both applications. Meteorological conditions during the applications are given in Table 1. Gypsy moth larvae were mainly in the first instar and insect development on the two application dates is given in Table 2. Leaves were about 50% expanded on red oak and 25% expanded on white oak at the time of application.

Kromekote cards were placed at 15m intervals at right angles to flight lines in the plots where this was feasible. Results of the analysis of these cards are given in Table 3.

Table 1. Meteorological conditions during spray applications.

Date	Air temp at 10m (°C)	Ground temp at 1m (°C)	% RH	Wind km/h
May 14	2.8-7.8	2.3-8.3	93.5-91.8	1.0-2.6
May 19	6.4-7.4	6.0-7.9	81.0-79.0	1.0-3.0

Table 2. Larval development at time of applications.

Date	% L1	%L2	%L3
May 14	99.8	0.2	0
May 19	84.8	10.0	5.2

Table 3. Spray card deposit on Kromecote cards.

Plot	Emitted volume (L/ha)	Application number	NMD ( $\mu\text{m}$ )	VMD ( $\mu\text{m}$ )	Dmax ( $\mu\text{m}$ )	No. of droplets $\text{cm}^2$ ( $\pm\text{SE}$ )
1	5.0	1	42.2	124.9	444.1	$21.0 \pm 2.7$
		2	31.8	91.4	308.4	$12.1 \pm 0.9$
2	5.0	1	43.4	164.6	378.3	$12.7 \pm 2.6$
		2	29.8	75.6	178.6	$9.2 \pm 2.1$
3	5.0	1	51.5	236.0	378.3	$12.1 \pm 0.8$
		2	34.1	87.0	211.0	$3.6 \pm 0.6$
4	2.5	1	48.3	147.0	493.2	$63.4 \pm 7.4$
		2	46.6	185.2	350.0	$5.3 \pm 0.8$
5	2.5	1	37.3	153.1	425.2	$35.4 \pm 3.3$
		2	41.2	147.6	250.0	$3.1 \pm 0.8$
6	2.5	1	43.9	145.0	459.2	$26.6 \pm 2.8$
		2	20.4	132.1	450.0	$9.3 \pm 0.8$

#### Assessment

Egg mass counts were made on ten  $10\text{m}^2$  (0.01 ha) sub-plots in each treated and check plot using methods developed by Forest Insect and Disease Survey staff. Numbers were converted to egg masses per hectare. Counts were made in early May before hatching commenced and the same plots were re-examined in mid-October. Treated and check plots were paired on the basis of pre-spray egg mass densities and reduction in egg mass density was calculated using a modified Abbott's formula.

Pupal counts were made from burlap traps on three oak (red or white) trees in each of the ten 0.01 ha sub-plots used for egg mass counts in all treated and check plots. Strips of burlap 45 cm wide were folded double and nailed to the trunks of trees. The circumference of the trees was measured and pupal counts were converted to pupae/m of burlap. Pupal counts were made during the week of July 9-13.

Pheromone trapping was undertaken and 3 traps were placed in each treated and check plot on June 9-10. Lures were supplied by Dr. B. Leonhardt of the USDA Laboratory at Beltsville, Md; the concentration of pheromone was greatly reduced to avoid excessively high catches in green Multipher gypsy moth traps containing a dichlorovos strip to kill the male moths. Traps were hung 12.5m from the ground and 0.5m from a tree trunk. The traps were removed on Aug. 3 at the end of the flight period and the catch of male moths counted.

Defoliation estimates were made on 5 red oak or white oak 46-cm branch tips collected at mid-crown from trees in the ten 0.01 ha sub-plots used for egg mass counts. This was done at 8 weeks after the first spray application when larvae had ceased feeding and were either pupating or dead. A total of 50 branch tips was examined in each treated and each check plot. An estimate was made of the amount of foliage consumed on each branch and a mean was calculated for the plot.

### Results

Pheromone trap counts of male moths are given in Table 4. Compared to check plots, the reduction in catches in the 2.5 L/ha treatment were 28, 36 and 46% and in the 5.0 L/ha treatment were 31, 42 and 78%.

Table 4. Moth catches in pheromone traps.

Plot no.	Emitted volume (L/ha)	Mean no. of moths/trap in treated plots (n=3)	Mean no. of moths/trap in corresponding check plots (n=3)	% catch reduction
1	2.5	559	1034	46
2	2.5	654	914	28
3	2.5	588	914	36
4	5.0	449	767	42
5	5.0	633	914	31
6	5.0	204	914	78

Pupal counts are given in Table 5. All counts were significantly lower than corresponding check plots. The mean number of pupae/m of burlap trap in the 2.5 L/ha treatments was 12, 14 and 17 compared to 61, 43 and 43 in corresponding check plots. In the 5.0 L/ha treatment the counts were 2, 8 and 11/m burlap trap compared to 37, 43 and 43 in corresponding check plots.

Egg mass counts in the spring and fall are given in Table 5 along with the population reductions due to the treatments calculated using a modified Abbott's formula. Population reductions in the 3 plots treated at 2.5 L/ha were 73, 82 and 90% and at 5.0 L/ha were 87, 91 and 95%.

Defoliation estimates are given in Table 5. There were significant differences in defoliation of all treated plots compared to check plots except in one of the 2.5 L/ha treatments which had 30% defoliation compared to 46% in its corresponding check plot. The remaining two 2.5 L/ha treatments had 34 and 46% defoliation compared to 77% in the check plot with which both were paired. In the 5.0 L/ha treatment defoliation of 29, 31 and 38% was matched with 77, 77 and 93% in corresponding check plots.

Table 5. Assessment of Disparvirus aerial spray trials.

Plot	Emitted volume (L/ha)	Pupae/m burlap ( $\pm$ SE)	Pre-spray EM/ha ( $\pm$ SE)	Post-spray EM/ha ( $\pm$ SE)	% population reduction due to treatment*	% defoliation of oak
Plot 1	2.5	12 $\pm$ 2	2280 $\pm$ 339	820 $\pm$ 164	90	30
Check	-	61 $\pm$ 6	2390 $\pm$ 471	8200 $\pm$ 1376	-	46
Plot 2	2.5	14 $\pm$ 2	3620 $\pm$ 267	2230 $\pm$ 472	73	46
Check	-	43 $\pm$ 5	3430 $\pm$ 664	7710 $\pm$ 1147	-	77
Plot 3	2.5	17 $\pm$ 2	3270 $\pm$ 588	1340 $\pm$ 305	82	34
Check	-	43 $\pm$ 5	3430 $\pm$ 664	7710 $\pm$ 1147	-	77
Plot 4	5.0	8 $\pm$ 2	8900 $\pm$ 932	1620 $\pm$ 244	87	38
Check	-	37 $\pm$ 3	6690 $\pm$ 1152	9560 $\pm$ 1172	-	93
Plot 5	5.0	11 $\pm$ 2	4360 $\pm$ 809	930 $\pm$ 130	91	29
Check	-	43 $\pm$ 5	3430 $\pm$ 664	7710 $\pm$ 1147	-	77
Plot 6	5.0	2 $\pm$ 1	3870 $\pm$ 572	420 $\pm$ 81	95	31
Check	-	43 $\pm$ 5	3430 $\pm$ 664	7710 $\pm$ 1147	-	77

\* Calculated using a modified Abbott's formula.

## Discussion

It is difficult to make definitive judgments on the basis of 3 plots per treatment and one year of data, but the inference is that the 5.0 L/ha was superior to the 2.5 L/ha using an aqueous tank mix. Using criteria of defoliation not exceeding 40% and post-spray egg mass densities not exceeding 1200/ha, one plot in the 2.5 L/ha treatment suffered 46% defoliation and two plots had post-spray egg mass densities of 1340 and 2230/ha, respectively. In the 5.0 L/ha treatment, all three plots suffered less than 40% defoliation and only one of the 3 plots had a post-spray egg mass density over 1200/ha. This particular plot had the highest pre-spray egg mass density of 8900 which was reduced to 1620/ha.

This was the first time that pheromone traps have been used as part of the assessment of a virus spray application in Canada. The reduction in the number of male moths was not as dramatic as the reduction in egg mass densities. This, however, is to be expected following a virus application, because the virus has a greater impact on female larvae than on male larvae. Female gypsy moth larvae have 6 instars as opposed to 5 for males, leaving the females longer in the larval stage and hence more chance of succumbing to a virus infection than the males.

## Conclusions and recommendations

From these results, it appears that a further reduction in emitted volume from 5.0 L/ha to 2.5 L/ha cannot be recommended with any confidence when using this aqueous tank mix containing molasses and Orzan<sup>LS</sup>. Results with the double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha) in 5.0 L/ha continues to be the recommended treatment for Disparvirus.

For Disparvirus to become an operational alternative to Bacillus thuringiensis, it will require a Canadian registration and a commercial source of the product. A registration petition for Disparvirus was submitted to Agriculture Canada in April 1990 and is currently being evaluated. FPPI staff have been negotiating with a Maryland company called Espro to establish a pilot plant in the Institute which will be followed in about 2 years by a commercial virus production facility in Sault Ste Marie. Funding is currently being sought from granting agencies. A commercial product will not be available for operational use in 1991, but, along with a Canadian registration, it is hoped that some gypsy moth viral insecticide will be available for use in 1992.

This research was funded, in part, by an Ontario Pesticides Advisory Committee Grant and, in part, by the Ontario Ministry of Natural Resources

Research Activity: Impact and fate of insecticides in the environment.

Principal Researchers:

1. K.M.S. Sundaram - Distribution, Deposition and Persistence of Bacillus thuringiensis (kurstaki) [B.t.(k)] in a Deciduous Forest Environment.

Undiluted Novo Foray<sup>R</sup> 48B Bacillus thuringiensis (k) formulation was sprayed in May 1990 over four blocks of a deciduous forest with oak stands in the Hawley area of eastern Pennsylvania at two dosage rates in duplicate at 20 BIU/53 US oz per acre (50 BIU/1.57 L per hectare) and 30 BIU/80 US oz per acre (75 BIU/2.37 L per hectare). Prespray and postspray oak foliage and simulated oak foliage samples were collected at intervals of time and stored in alkaline buffer with  $\text{NaN}_3$  for assaying the concentration levels of B.t.(k) (60 kilodalton, kDa) toxin. B.t. deposits in ground samplers (glass-fiber discs mounted on collection units and alkaline buffers in petri-dishes) were also collected at 1h postspray. Droplet densities (droplets/cm<sup>2</sup>) and droplet size distributions (NMD, VMD,  $D_{\text{max}}$  and  $D_{\text{min}}$ ) were measured at canopy and ground levels using Ciba-Geigy water sensitive papers (10 mm x 26 mm) mounted or fastened onto supports.

Gypsy moth larvae were bioassayed (force feeding) against the alkaline buffer extract of the formulation (Novo Foray<sup>R</sup> 48B), and a calibration curve (% mortality vs concn. of 60 kDa) was prepared. Pre- and postspray B.t.(k) extracts of simulated and natural oak foliage were bioassayed and the mortalities of the larvae determined. Using the calibration curve, the concentration of the 60 kDa B.t.(k) in the analytes were established. The concentrations of the 60 kDa B.t.(k) in different extracts were also quantified by using an enzyme-linked immunosorbent assay (ELISA) developed cooperatively by the author and Dr. D.B. Hammock (Univ. Calif., Davis, CA). The ELISA studies are in progress and involve the coating of the microtiter plates successively with goat anti B.t.(k), addition of analyte [B.t.(k) extract], addition of rabbit anti B.t.(k), goat anti-rabbit IgG (enzyme labeled) and developing a yellow color for spectroscopic quantification with the addition of a substrate. Using the bioassay and ELISA data, the distribution and persistence of B.t.(k) as 60 kDa will be evaluated. If efficacy data are made available, attempts will be made to correlate the residue levels with observed larval mortality.

Collaborative Research Areas:

The principal researcher will be pleased to interact with researchers interested in the above areas, viz; B.t. deposit assessment, B.t. quantification via bioassay and ELISA and evaluation of the persistence and fate of B.t. in a forest environment.

## 2. Stephen B. Holmes (Project Leader) and D.P. Kreutzweiser - Effects of B.t. on Non-Target Organisms.

B.t. is the most widely used forest pest control product in Canada. When it was still a minor component of forest spray programs, relatively little attention was paid to the environmental effects of B.t. Concern was focussed more on the chemical insecticides, such as fenitrothion, because these were perceived as being more damaging to the environment. Now, however, because of its increased use, B.t. is being looked at more closely.

At the Forest Pest Management Institute (FPMI), three studies that deal with the environmental impacts of B.t. spraying are underway. Each of these studies is described briefly below:

### Toxicity of B.t. to Stream Insects

Relatively little has been published in the scientific literature on the toxicity of B.t.k. (*Bacillus thuringiensis kurstaki*) to aquatic insects. Eidt (1985) tested 9 taxa of aquatic insects, representing 4 major orders, Trichoptera, Plecoptera, Ephemeroptera and Diptera, for susceptibility to B.t. at concentrations of 4.3, 43 and 430 IU/mL under static conditions. The concentrations were chosen to represent a worst-case field situation, a 10X overdose and a 100X overdose, respectively. Only one species of blackfly was clearly affected by the B.t., and this was at the highest concentration. Although effects on other species were suggested, Eidt concluded that the risk to aquatic insects was low and that buffer zones were not required around water bodies for aerial spraying with B.t.k.

There are currently no buffer zones around standing water for aerial spraying with B.t. in Newfoundland, New Brunswick, Quebec and Ontario (Kingsbury and Trial 1987). Nova Scotia requires a 30 m setback for aerial spraying of all pesticides, including B.t. (Kingsbury and Trial 1987).

Recently, concern has been expressed by Environment Canada, Conservation and Protection, in British Columbia that the data base for B.t. is too limited to adequately assess the requirement for buffer zones around fishery sensitive streams. They suggest that further testing is needed, and that, until the information from these tests is available, a buffer zone of 10 m should be imposed.

In order to fill one of the data gaps identified by Environment Canada (i.e. the need for more comprehensive and reliable toxicity data), FPMI is conducting laboratory and field bioassays with B.t. and stream insects. The apparatus used in the laboratory tests is a flow-through design (Rodrigues and Kaushik 1984) that more closely simulates the natural stream environment than the static system of Eidt (1985). The initial test for each species is performed at 100X the expected environmental concentration (EEC) as calculated by the Department of Fisheries and Oceans Canada (i.e.  $100 \times 6$  IU/mL). The total exposure and observation periods are 24 and 216 h, respectively. If a positive response is observed at this concentration, an additional test is conducted to determine the LC50. Field bioassays are performed in artificial stream channels. These tests concentrate on a sublethal response (i.e. induced drift) to the insecticide. The concentrations tested are arrived at in the same way as in the laboratory tests, except that an EC50 is calculated. The exposure and observation periods are 2.5 and 168 h, respectively. To date, 6 species

have been tested using this approach (Heptagenia flavescens, Stenonema sp., Isonychia sp., Isogenoides sp., Acroneuria sp., and Hydropsyche sp.), and no lethal or sublethal effects have been detected at 100X the EEC.

### 3. Principal Researcher: Kevin Barber - Relative Susceptibility to B.t. of Non-target Lepidoptera Larvae.

According to Dimond and Morris (1984), the larvae of 200 species of Lepidoptera are known to be susceptible to B.t.k. In addition, field studies have shown that B.t. spraying to control forest pests can significantly reduce populations of non-target Lepidoptera (Bendell 1986, Miller 1990). Lepidoptera are ecologically important because they function in food webs as herbivores and because they are a food resource for birds and other wildlife (Miller 1990). Lepidoptera are also esthetically valuable to amateur and professional naturalists and entomologists.

Studies at FPMI with B.t. and non-target Lepidoptera have focussed primarily on the caterpillar fauna of blueberry (Vaccinium angustifolium). These caterpillars are an important food resource for grouse, songbirds and small mammals in jack pine plantations. The relationship between B.t. spraying to control jack pine budworm and secondary effects on non-target wildlife was initially explored by J.F. Bendell of the University of Toronto (Bendell 1986, Innes and Bendell 1989), and some field work described below was conducted cooperatively with him.

In 1989, two 80 ha blocks of jack pine forest near Gogama, Ont. were aerially sprayed with B.t. Effects on blueberry leaf-feeding Lepidoptera were assessed in two ways: 1) larval populations were sampled by sweep netting along transects in treated and control areas, before and after spraying; and 2) field bioassays were conducted in which Itame brunneata (Lepidoptera: Geometriidae) larvae, one of the most abundant caterpillar species on blueberry at the time of treatment, were fed blueberry foliage collected from sprayed and unsprayed areas. Preliminary results suggest that caterpillar numbers were reduced on blueberry for up to 15 days after treatment. Results for individual taxa are not yet available. In the bioassays, mortality rates for Itame brunneata were in the range of 28-41%.

In addition to the studies described above, laboratory bioassay protocols are being developed for non-target Lepidoptera larvae. This includes establishment of laboratory cultures of important species. Attempts to rear Itame brunneata have met with only limited success so far. Better progress is being made with some other common species from blueberry (e.g. Orthosia revicta (Lepidoptera: Noctuidae)). In the laboratory bioassays, a number of dosing procedures are being investigated, including direct oral intubation and feeding of contaminated leaf disks and diet plugs.

### Principal Researcher: R. Millikin - Secondary Effects of B.t. Spraying on Forest Songbirds.

Lepidoptera larvae are the preferred food for most breeding insectivorous forest birds (MacArthur 1958, Holmes and Schultz 1987), and are important for the growth and survival of the young of omnivorous species (Petersen and Best 1986, Johnson and Boyce 1989). By reducing the availability of caterpillar prey, B.t. spraying could indirectly affect forest birds.

In 1989, a study was conducted to determine the effect of B.t. spraying on the reproductive success of ground-nesting songbirds in jack pine plantations. This study took place in the same blocks as the caterpillar work described above. The methods used included singing-male censuses, observations of foraging behavior and feeding of young, collection of food samples from ligated nestling, determination of nestling growth rates and survival, and mist-netting of banded individuals.

The results are preliminary, but the following general observations can be made. Fewer food items were brought to hermit thrush young in the treated areas than in the control areas (4.8 versus 6.8 items/crop sample, respectively), and Lepidoptera larvae made up a significantly smaller component of the diet of treated nestlings (7% of food items versus 58% in control). These differences in diet did not translate into differences in growth rate or survival of nestlings (the probability of survival in the treated area was 0.40 and in the control was 0.23). The results were generally similar for other ground-nesting bird species (i.e. junco, white-throated sparrow and black and white warbler). Considering ground-nesting birds as a group, there was no significant difference in the proportion of young caught by mist-netting in the treated versus the control areas (21% and 25% of the total catch, respectively), or in the ratio of young to adult females. It is concluded that the observed reduction in caterpillar food resulting from the B.t. spray did not have a significant adverse effect on the growth or survival of young ground-nesting songbirds.

The studies described above are ongoing within the Environmental Impact Project of FPMI. David P. Kreutzweiser is responsible for aquatic toxicology studies, Kevin N. Barber for non-target Lepidoptera bioassays and Rhonda L. Millikin for forest songbird studies.

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#### **Collaborative Research Areas: (Contact the project leader - S. Holmes)**

- 1) Laboratory and field toxicity testing of forestry pesticides (hexazinone, trichlopyr and B.t.) on non-target aquatic invertebrates in flow-through systems.
- 2) Development of standardized methodologies to test the side-effects of pesticides on beneficial terrestrial arthropods. Establishing laboratory cultures of non-target Lepidoptera and conducting bioassays with B.t. and gypsy moth NPV.
- 3) Secondary effects of B.t. spraying on forest songbirds.
- 4) Development of microcosms to study the fate and environmental effects of microbial forest pest control products in the laboratory.

#### **Research Activity: Control of Eastern Defoliations**

Principal Researcher: A. Sundaram - Research Studies on Physicochemical Aspects of Pesticide Performance (conducted in 1990).

During 1990, the Pesticide Formulations Project at FPMI undertook two field studies, and two laboratory studies to examine (i) the influence of physicochemical properties of the end-use mixtures on droplet size spectra of the spray cloud, droplet spreading on foliage, and deposits on glass plates; and (ii) the rainfastness of foliar deposits of B.t. and glyphosate formulations.

### Field Studies:

#### Effect of Droplet Size and Cumulative Rainfall on Rainfastness of Foray 48B deposits on balsam fir foliage under field conditions:

A small scale field study was conducted using the single tree treatment technique to determine the rain-fastness of foliar deposits of B.t. as determined by spruce budworm bioassay using 4th instar larvae. Foray 48B was diluted with water and sprayed over balsam fir seedlings (about 1 m high) at a dosage rate of 32 BIU in 4 L per ha, using a spinning disc atomizer, Micron Flak<sup>R</sup>, calibrated to generate a narrow drop size range with an NMD of 80  $\mu$ m and a VMD of 86  $\mu$ m. Drops were counted on fully flushed needles and drops per sq. cm were evaluated.

Simulated rainfall of two different drop size spectra (almost monosized drops), with VMD values of 250 and 400  $\mu$ m, and two different cumulative rainfalls of 1 and 3 mm, were generated using Micron Herbi<sup>R</sup>, and applied onto the seedlings at 24 h after B.t. application. Foliar branch tips containing fully flushed young buds were collected at different intervals of time up to 14 d after B.t. treatment, for bioassay using laboratory reared spruce budworm larvae. Mortality was assessed daily, and body weight depression once in two days, for a period of 14 days after treatment.

A comparative evaluation of the data on post-spray (within 15 min after application) and pre-rain samples (i.e., those collected at 24 h post-treatment) indicated that about 30% of B.t. activity was lost in 24 h after application. B.t. deposits were washed off under both intensities of rainfall, but wash-off was significantly higher at 3 mm than at 1 mm rain. Cumulative rainfall influenced B.t. wash-off from fir foliage much more than the droplet size of rain. Body weights were more depressed and mortality was higher in insects fed with buds collected before the rainfall, than with those collected post-rain. The data will be used to develop a model to understand the inter-relationships between size and impact velocity of rain drops, cumulative rainfall, and B.t. wash-off from balsam fir foliage.

Body weight depression and bioassay results on samples collected up to 14 d after treatment from seedlings that received no rain indicated that initial loss of B.t. activity was rapid within two days after treatment (a loss of about 50% of the deposited amount) but further loss was relatively slow. Measurable but very low B.t. activity still persisted for up to 9 to 10 d after treatment. This was detectable both by body weight depression and by low larval mortality. Further studies are on the way to understand the mechanism of loss of B.t. activity from treated foliage.

**Collaborative Research Areas:** The principal researcher will be willing to collaborate with USFS researchers in the following areas:

- 1) Factors contributing to the rainfastness of pesticides (e.g. droplet size and formulation properties)
- 2) Pesticide mechanisms.

- 2) Principal Researcher: Leo Cadogan - Efficacy of Dipel 352 (Dipel 16L) against spruce budworm.

A trial was conducted in NW Ontario to determine the efficacy of Dipel 352 (Dipel 16L) against fairly high (25 to 62 larvae/45 cm branch) populations of spruce budworm. The B.t. was sprayed undiluted at 30 BIU/ha (0.9 l/ha) and the budworm responses were examined on black spruce Picea mariana and balsam fir Abies balsamea species with widely different phenological developments.

One treatment matched the development of balsam fir (= peak budworm  $L_4$ ) and the other block was sprayed 9 days later to match black spruce's development (= peak  $L_5$ ). Results indicate that when the spray was timed to suit balsam fir development, budworm population reduction was less on both host species than when it was timed to suit black spruce.

In both blocks, defoliation was not different from that in the control. This suggests that these treatments were not effective against high budworm populations in protecting host tree foliage.

**Areas of Collaborative Research:** The principal researcher would like to collaborate with USFS researchers in the following areas:

- 1) Experimental design, methods and evaluation of aerial field trials.
- 2) Spraying and block marking techniques.
- 3) Responses of defoliations to insecticides.

3) Principal Researchers: Kees van Frankenhuyzen and Vince Nealis

- a) Dose acquisition of B.t. by spruce budworm in relation to larval development, foliar deposits and persistence and weather conditions.
- b) Foliar persistence of aerially applied B.t. on balsam fir in relation to weather conditions.
- c) The influence of B.t. application timing on the survival of some spruce budworm parasitoids.

This research was conducted simultaneously with the efficacy trial. The results are currently being analyzed. Contact Kees van Frankenhuyzen or Vince Nealis for further information.

### 3) Principal Researcher: B.V. Helson - Insecticide Toxicology

#### a) New Insecticide Development

We have been assessing the potential of 4 new insecticides for the control of forest defoliators; alpha-terthienyl, RH5992, abamectin and its semi-synthetic derivative, MK-243 in the laboratory. Alpha-terthienyl, a natural phototoxic compound from members of the plant family, Asteraceae, has previously been tested on spruce budworm, jackpine budworm, eastern hemlock looper, forest tent caterpillar, white-marked tussock moth, and black army cutworm in collaboration with Dr. J.T. Arnason and A. Ceccarelli, U. of Ottawa and Dr. W.J. Kaupp, FP.I. In 1990 alpha-terthienyl was evaluated on gypsy moth larvae, but further tests are needed to confirm its toxicity. To date, all tests have been topical applications followed by exposure to near-UV light. We plan to assess its toxicity to SBL and EHL by ingestion and crawling contact exposure.

RH5992 is a novel insect growth regulating compound discovered by Rohm and Haas and under development by them. Dr. A. Retnakaran, FP.MI, and I have been evaluating this compound against several forest lepidopteran defoliators. I have examined its toxicity to spruce budworm, eastern hemlock looper and gypsy moth larvae by direct contact and on sprayed foliage as well as its effects on feeding rates. In addition, the effects of exposure period on toxicity and the residual toxicity of RH5992 are being investigated.

Abamectin has been isolated from a soil microorganism, Streptomyces avermitilis by the Merck Sharp and Dohme Research Laboratories and is now registered as an miticide in the USA. MK-243, a semi-synthetic derivative of abamectin, has recently been developed and is reported to have very high activity to Lepidoptera. We have just begun testing MK-243 on SBL and EHL in comparison with abamectin. It appears to be very potent to these pests. We plan to expand our screening program against several other forest pests including gypsy moth.

#### b) White Pine Weevil

For several years we have been assessing the potential of pyrethroids, particularly permethrin, for the control of WPW adults in the laboratory with encouraging results. In 1990, P. deGroot, FP.MI, and I collaborated in conducting a field trial to assess the effectiveness of permethrin in protecting leaders of jackpine from weevil attack. Leaders were sprayed by hand with dosages of 70 and 140 g AI/ha in early spring. Methoxychlor was sprayed at 1 kg/ha as a standard for comparison.

#### c) Pine False Webworm

In 1990, D.B. Lyons, Forestry Canada, Ontario Region, and I collaborated in laboratory and field trials to develop an insecticide control strategy for the pine false webworm on red pine. Laboratory bioassays with 10 common, registered insecticides were carried out with newly hatched larvae on sprayed red pine branches. Field trials were then conducted with Ambush 500EC (permethrin) at 35, 70 and 2 x 35 gAI/ha, and Sevin XLR Plus (carbaryl) at 12, 250, 500 and 2 x 125 gAI/ha applied by mistblower in a red pine plantation.

## d) Seedling Debarking Weevil

For the past three years we have been conducting insecticide bioassays with Hylobius congener adults in cooperation with Bruce Pendrel, Foresty Canada, Maritimes Region. The residual effectiveness of permethrin, chlorpyrifos and fenitrothion for protecting conifer seedlings for up to 2 years is being evaluated by spraying or dipping potted white spruce and red pine seedlings with selected concentrations of these insecticides, placing the seedlings outdoors and exposing weevils to them at yearly intervals.

## e) Other Pests

We recently completed field trials to determine the efficacy and optimum timing of permethrin for the control of spruce budmoth, Zeiraphera canadensis larvae in cooperation with M. Auger, Quebec Ministry of Energy and Resources. We are currently screening insecticides against Conophthorus cone beetles in collaboration with P. deGroot. We also conducted preliminary insecticide bioassays on black headed budworm, Acleris variana this year.

Collaborative Research Areas: The principal researcher is willing to collaborate in laboratory and field studies relating to these or other promising new products and to the development of insecticide control strategies for the above pests and others of potential importance in Canada if resources and time permit.

## 4) Principal Researcher: John C. Cunningham - Virus Application Project

a) Gypsy Moth

Most of the activity of the virus application project has been focussed on gypsy moth for the last 3 years. A registration petition for Disparvirus, the name given to our Canadian product, was submitted in April 1990 and is currently being evaluated. Much of the data in this package were obtained from the Gypchek registration petition.

In 1988, a double application of Disparvirus at  $1.25 \times 10^{12}$  PIB/ha (total  $10^{12}$  PIB/ha) in an emitted volume of 10.0 L/ha using an aqueous tank mix gave excellent results when applied on first instar larvae. However, this dosage and emitted volume are both considered to be too high for operational use. In 1989, a double application of  $5 \times 10^9$  PIB/ha (total  $10^{12}$  PIB/ha) was tested at 10.0 L/ha and 5.0 L/ha on first instar larvae. The aqueous tank mix contained 25% molasses, 10% Orzan LS and 2% Rhoplex B60A sticker. The lower dosage was also deemed to be satisfactory. Hence the recommendation for Disparvirus application was changed to a double application of  $5 \times 10^{11}$  PIB/ha in 5.0 L/ha.

In 1990, a further reduction in emitted volume to 2.5 L/ha was tested and compared to 5.0 L/ha using the aqueous tank mix. Results with 2.5 L/ha were not as good as 5.0 L/ha, so a further reduction in emitted volume is not recommended when using this aqueous tank mix. A trial was also conducted during the 1990 season, with Gypchek, which was supplied by USDA Forest Service colleagues. The dosage was a double application of  $5 \times 10^{11}$  PIB/ha (total  $10^{12}$  PIB/ha) in 5.0 L/ha using an emulsifiable oil tank mix. Larvae were mainly in the first instar at the time of application. The tank mix contained 25% Dipel 176 blank carrier vehicle and 75% water. Excellent results were obtained and it is suggested that this tank mix and dosage be tested at an emitted volume of 2.5 L/ha.

A commercial source of gypsy moth viral insecticide is vital if it is going to be used operationally in Ontario. FPMI is negotiating with Espro and several funding agencies with a view to establishing a pilot plant in the Institute and eventually a production facility in Sault Ste. Marie.

b) Douglas-fir Tussock Moth

A Canadian viral insecticide for Douglas-fir tussock moth called Virtuss and the USDA Forest Service product called TM BioControl-1 were both registered in Canada in 1983. In 1983, the last outbreak of Douglas-fir tussock moth in B.C. terminated and neither of these products has been used operationally. B.C. Forest Service holds supplies of sufficient TM BioControl-1 to treat 8,000 ha and sufficient Virtuss to treat 1,400 ha. An outbreak of Douglas-fir tussock moth is predicted for 1991; these products will be applied operationally if the outbreak occurs.

The recommended dosage of virus for Douglas-fir tussock moth is  $2.5 \times 10^{11}$  PIB/ha in either an aqueous, molasses and Orzan tank mix or an emulsifiable oil tank mix applied at 9.4 L/ha. Non-replicated trials in 1982 indicated that a lower dosage,  $8.3 \times 10^{10}$  PIB/ha, gave acceptable results. The virus is known to spread and "seeding" it into the insect population using widely spaced swaths has been suggested.

c) Redheaded Pine Sawfly

Lecontvirus, for control of redheaded pine sawfly, was registered in Canada in 1983. It is the only viral insecticide which is routinely used on an operational basis in Canada. Our principal client has been the Ontario Ministry of Natural Resources, although Quebec Department of Energy and Resources used Lecontvirus experimentally in the 1970's and have requested material for 1991. Dosage is  $5 \times 10^9$  PIB/ha applied in 10.0 L/ha from the air and 20.0 L/ha with ground spray equipment. The virus is produced inexpensively by treating heavily infested plantations and harvesting diseased and dead colonies of larvae. Between 1976 and 1990, 590 red pine and jack pine plantations with a total area of 4,855 ha have been treated.

d) European Pine Sawfly

A registration petition for Sertifervirus to control European pine sawfly was submitted in 1985 and is still being evaluated. The petition was based on the USDA Forest Service Neochek-S petition. The American product was registered by EPA in 1983 for use in the USA. European pine sawfly virus was extensively used on infested Scot's pine Christmas tree plantations in Ontario in the 1950's and 1960's with no thought given to registration and no records kept of areas treated. This insect is currently only a minor pest. Between 1976 and 1990 only 4 plantations, with a total area of 160 ha, have been treated. However, if a registration is obtained for Sertifervirus, greater use will be made of this product. Recommended dosage of  $5 \times 10^9$  PIB/ha is the same as that for Lecontvirus. Sertifervirus is also produced by spraying heavily infested plantations and harvesting diseased and dead colonies of larvae.

APPLICATION OF DISPARVIRUS AGAINST GYPSY MOTH IN ONTARIO IN 1990.

A report to the 18th Annual Forest Pest Control Forum

(Ottawa, Ontario. 20-22 November 1990)

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## NORTH CAROLINA GYPSY MOTH PROGRAM 1990 OPERATIONS SUMMARY

The North Carolina Department of Agriculture (NCD-A) in cooperation with the North Carolina Division of Forest Resources, the USDA-APHIS-PPQ and the USDA-Forest Service conducted an ongoing program of survey, detection, and eradication for the gypsy moth during 1990. The survey entailed a burlap banding and trapping program in all one hundred counties. The trapping data for North Carolina's gypsy moth program has not been fully summarized. As of October 3, records summarized indicate 3,968 moths caught in 14,573 pheromone-baited delta traps. A preliminary breakdown of these data by trap type showed that 7,709 comprehensive traps were placed at one trap per four square miles, 2,061 priority traps were placed at high risk sites such as campgrounds, and 4,803 delimiting grid traps placed at treatment and mass-trapping sites. A summary of results to date is included in this report. Based on an evaluation of the final trapping data, egg mass surveys will be conducted during the fall with completion due by the end of December.

Efforts to eradicate known infestations within the state included the use of Bt (*Bacillus thuringiensis*), Diflubenzuron, and mass trapping. The 1990 treatment program involved operations in eight counties. Ground treatments utilizing hydraulic and mistblower type sprayers were conducted at four locations using two or three applications of Foray 48B™ and/or two applications of Dimilin 25W. Foray 48B™ was applied at the rate of 53 ounces per acre (20 BIU), and Dimilin 25W was applied at the rate of 2 ounces per acre (1/2 AI per acre). Nine sites were treated by air in 1990 and included one site each at Scotland Neck (900 acres in Halifax County), Enfield (200 acres in Halifax County), Windsor (1,350 acres in Bertie County), Drew (300 acres in Bertie County), Woodville-Lewiston (650 acres in Bertie County), Roanoke Rapids (150 acres in Northampton County), Margarettsville (200 acres in Northampton County), Como (1,300 acres in Hertford County), and Grove Hill (50 acres in Warren County). The Warren County site was treated with Gyp-Chek under a cooperative project with USDA-APHIS and USDA-Forest Service.

The aerial treatments were conducted using two Cessna AgTrucks each equipped with eight Micronair rotary atomizers. Two applications of Foray 48B™ were made at the rate of 53 ounces per acre (20 BIU). The first application was made on Saturday, April 7, and completed on Monday, April 9. The second application was made on Wednesday, April 18, and completed on Friday, April 20. Several of the aerial sites received ground treatments at the center of the infestation using either Foray 48B™, Diflubenzuron or Sevin®.

Weather patterns during the spray operations were generally fair. The wind direction was primarily from the northeast and northwest resulting in a dry air mass with low relative humidity, 45% to 60% in the early morning (prior to 11:00) and 32% to 38% in the afternoon. Winds stayed within the contract limits of 8 mph or less, averaging 3-4 mph over the course of each operation. There was no rainfall during the first round of treatments; however, the start of the second round was delayed approximately two hours due to a light misty rain early in the morning. Temperatures during the spray operations remained relatively cool, allowing for both morning and afternoon spray operations. Temperatures ranged from a low of 32° to a high of 78°.

A summary and description of the treatment sites is included in this report.

County	Total Adult Traps			Positive Traps			Multiple Traps			Total
	C	P	+	C	P	+	C	P	+	Moths
Lee	58	2		1						1
Lenoir	89	5								0
Lincoln										*
McDowell		5								0 *
Macon	89	142			1					1
Madison		11								0 *
Martin	103	6	9	2			1			3
Mecklenburg	116	10		1						1
Mitchell		3								0
Montgomery	116	13								0
Moore	145	4		2	1		1			4
Nash	121	6	26	8	1			1		10
New Hanover	49	12	76							0
Northampton	131	42	350	13	8	52	3	1	23	142
Onslow	120	77		2	5					7
Orange	95			3			1			4
Pamlico	80	3		1						1
Pasquotank	51	101		22	42		7	12		105
Pender	142	5								0
Perquimans	61	53		8	10		2	1		22
Person	98			15			6			22
Pitt	142	18	7		1	1				2
Polk										*
Randolph		1								0 *
Richmond	94	8								0
Robeson	217	16								0
Rockingham										*
Rowan	113									0
Rutherford										*
Sampson	197	30	60	3	3	3	1	2		18
Scotland	62	7								0
Stanly	98	2								0
Stokes										*
Surry		2								0 *
Swain		58			3					3 *
Transylvania		15								0 *
Tyrrell	81	19		8	3		2			14
Union	143	3			2			1		5
Vance	66	8	121	9	3	2	2	2		23
Wake	194	27		4						4
Warren	97	2	424	2	2	114	1	1	99	1,146
Washington	75	34		2	1					3
Watauga		11								0 *
Wayne	109	23		1						1
Wilkes	157	16		1			1			2
Wilson	80	4								0
Yadkin										*
Yancey	—	7	—	—	—	—	—	—	—	0 *
TOTALS	7,709	2,061	4,803	317	339	446	113	149	222	3,968

C = Comprehensive (1/4 sq.mi.) P = Priority (High Risk) + = 25/sq.mi. to 9/acre

**NORTH CAROLINA GYPSY MOTH PROGRAM  
1990 GYPSY MOTH TRAPPING DATA**

County	Total Adult Traps			Positive Traps			Multiple Traps			Total Moths
	C	P	+	C	P	+	C	P	+	
Alamance	109			4						4
Alexander										*
Alleghany		8			2					2 *
Anson	113	5								0
Ashe		3								0 *
Avery		5			2			1		4 *
Beaufort	204	41		8	1		1			10
Bertie	188	64	834	10	5	60	2		9	93
Bladen	201	18								0
Brunswick	144	14								0
Buncombe		15								0 *
Burke		18								0 *
Cabarrus										*
Caldwell	73	7								0
Camden	46	19		24	8		19	6		132
Carteret	55	60	214	4	7	29		2	4	49
Caswell	99	1		5						5
Catawba										*
Chatham	140	19		2	1					3
Cherokee		19	25							0 *
Chowan	46	66		6	7		2	1		16
Clay	32	82	591			3			2	5
Cleveland										*
Columbus	207	3								0
Craven	113	32	1	1	1					2
Cumberland	132	32	556	4		22			5	44
Currituck	63	19		35	8		24	4		650
Dare	94	382		20	181		7	104		712
Davidson	120	21	10	1			1			2
Davie										*
Duplin	179	7		2	1					3
Durham	71	8		1			1			2
Edgecombe	118	12	25	3	2		2			10
Forsyth	94									0
Franklin	79									0
Gaston										*
Gates	76	32		24	9		11	4		93
Graham		20								0 *
Granville	120	2		14	1		2			17
Greene	58									0
Guilford	149	5	460	3		20	1		6	43
Halifax	167	6	692	18		97	7		61	379
Harnett	140	7								0
Haywood	67	60								0
Henderson		5								0 *
Hertford	80	44	225	12	12	35	3	5	10	108
Hoke	76	12								0
Hyde	114	23	97	7	1	8	2		3	30
Iredell										*
Jackson	79	39			1					1
Johnston	183	7		1	3			1		5
Jones	91	8								0

**GYPSY MOTH TREATMENTS IN NORTH CAROLINA  
1974 - 1990**

<u>YEAR</u>	<u>LOCATION (COUNTY)</u>	<u>SITE DESCRIPTION</u>	<u>TOTAL TREATMENT ACRES</u>	<u>MATERIAL</u>	<u>RECURRENCE</u>
1974	Winston-Salem (Forsyth)	School	1,050	Carbaryl	None.
1979	Land Harbors (Avery)	Residential	1,370	Diflubenzuron	None.
1982	Raleigh (Wake)	Residential	370	Bt (Dipel)	None.
1982	Selma (Johnston)	Campground	200	Diflubenzuron	None.
1983	Beaufort (Carteret)	Lumberyard	150	Disparlure Flakes	Yes.
1984	Locust Gap (Watauga)	Forested	2,360	Bt (Dipel) Diflubenzuron	Scattered moths outside treatment area.
1984	Linwood (Davidson)	Lumberyard	6	Diflubenzuron	Yes.
1984	Beaufort (Carteret)	Lumberyard	4	Bt (Dipel)	Yes.
1985	Enfield (Halifax)	Forested	12	Diflubenzuron	None.
1985	Roanoke Rapids (Halifax)	Forested	8	Diflubenzuron	None.
1985	Frisco (Dare)	Campground	16	Bt (Dipel)	None.
1985	Greensboro (Guilford)	Residential	6	Bt (Dipel)	Yes.
1985	Locust Gap (Watauga)	Forested	4,180	Bt (Dipel)	None.

<u>YEAR</u>	<u>LOCATION (COUNTY)</u>	<u>SITE DESCRIPTION</u>	<u>TOTAL TREATMENT ACRES</u>	<u>MATERIAL</u>	<u>RECURRENCE</u>
1989	Henderson (Vance)	Residential	4	DiFlubenzuron	Yes.
1989	Norlina (Warren)	Residential	1	DiFlubenzuron	Yes.
1989	Greensboro (Guilford)	Residential	8	DiFlubenzuron	Yes.
1989	Cashie (Bertie)	Golf Course	18	Bt (Foray)	Yes.
1989	Cashie (Bertie)	Golf Course	154	Bt (Foray)	Yes.
1989	Grove Hill (Warren)	Forested	84	Bt (Foray)	Yes.
1989	Old Trap (Camden)	Forested	72	Bt (Foray)	Yes.
1989	Winton-Ferry Ridges (Hertford-Gates)	Forested	8,114	Bt (Foray)	Yes.
1989	Beech Swamp (Halifax)	Forested	94	Bt (Foray)	Yes.
<hr/>					
1990	Fayetteville (Cumberland)	Forested	20	DiFlubenzuron	Evaluation continuing.
1990	Piney Green (Sampson)	Residential	2	DiFlubenzuron Bt (Foray)	Evaluation continuing.
1990	Ocracoke Village (Hyde)	Residential	3	Bt (Foray)	Evaluation continuing.
1990	Moonlight (Halifax)	Farm	10	DiFlubenzuron Bt (Foray)	Evaluation continuing.
1990	Scotland Neck (Halifax)	Forested	1,800	Bt (Foray)	Evaluation continuing.
1990	Enfield (Halifax)	Forested	400	Bt (Foray)	Evaluation continuing.
1990	Windsor (Bertie)	Forested	2,700	Bt (Foray)	Evaluation continuing.

<u>YEAR</u>	<u>LOCATION (COUNTY)</u>	<u>SITE DESCRIPTION</u>	<u>TOTAL TREATMENT ACRES</u>	<u>MATERIAL</u>	<u>RECURRENCE</u>
1990	Drew (Bertie)	Forested	600	Bt (Foray)	Evaluation continuing.
1990	Woodville-Lewiston (Bertie)	Forested	1,300	Bt (Foray)	Evaluation continuing.
1990	Roanoke Rapids (Northampton)	Forested	300	Bt (Foray)	Evaluation continuing.
1990	Margaretsville (Northampton)	Forested	400	Bt (Foray)	Evaluation continuing.
1990	Como (Northampton /Hertford)	Forested	2,600	Bt (Foray)	Evaluation continuing.
1990	Grove Hill (Warren)	Forested	100	Gyp-Chek	Evaluation continuing.

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## 1990 Gypsy Moth Spray Site Description

1. Windsor, Bertie County. This 1,350 acre consists of a recreational-industrial-municipal use area and a densely wooded swamp adjacent to the Cashie River. The site is immediately to the south and west of the town of Windsor (see Map, Windsor site). Dominant tree species include willow, gum, oak, and southern yellow pine. This site encompasses a 75 acre block treated in 1989 for gypsy moth. Numerous residences, businesses and municipal buildings are within this site, including the Bertie-Martin Regional Jail, the Bertie Public Schools bus garage, the Town of Windsor Sanitary Sewage Disposal Plant, the Cashie Golf Club, and the National Guard Armory. Numerous creeks in the spray block drain into the Cashie River.

Ninety-five moths were recovered from this site in 1989. Ten apparently viable egg masses were observed during the course of a series of egg mass surveys conducted in November and December, 1989. Over twenty thousand egg masses per acre existed in a central "core" area prior to 1989 spray activities, resulting in numerous spent egg masses in this area. The abundance of spent egg masses may be serving to camouflage viable egg masses. Although the origin of this infestation is not known, it may be related to a trucking company which is situated approximately 100 feet from this core area. This site will receive two applications of Bt at 20 BIU/AC with follow up treatments in and around the core area.

2. Drew, Bertie County. This site consists of 300 acres of woodland along the Roquist Pocossin in Bertie County (see Map, Woodville-Lewiston site). It is a swampy, sparsely populated area located approximately 8 miles northwest of the town of Windsor. Dominant tree species include willow, gum, oak, and yellow pine. A total of 95 moths and 4 egg masses were recovered from this site in 1989. The origin of this infestation is not known. This site received two applications of Bt.

3. Woodville-Lewiston, Bertie County. This site consists of 650 acres of woodland along the Roquist Pocossin in Bertie County (see map, Woodville-Lewiston site). It is a swampy, sparsely populated area located approximately 19 miles northwest of the town of Windsor and 11 miles northwest of the proposed treatment site at Drew. Dominant tree species include willow, gum, oak, and yellow pine. A total of 39 moths and 229 egg masses were recovered from this site in 1989. The origin of this infestation is not known. This site received two applications of Bt with follow up treatments to the core area.

4. Margarettsville, Northampton County. This 200-acre site is located in Northampton County immediately south of the Virginia-North Carolina border and is adjacent to the Meherrin River (see map, Margarettsville site). It is approximately 8 miles west of the dominant tree species being gum and river birch. This area is managed by the Northampton Hunt Club. Thirty-four moths and three egg masses were recovered from this site in 1989. Although the origin of this infestation is not known, it may be associated with the activities of Northampton Hunt Club members or with the forestry industry. This site received two applications of Bt at 20 BIU/AC.

5. Como, Northampton County. This 1,300-acre site is a wooded, swampy area located two miles south of the Virginia-North Carolina border in Northampton and Hertford Counties (see map, Como site). Situated on the Meherrin River, this site straddles the border of Northampton and Hertford Counties. The proposed treatment area is primarily a swampy, wetland area composed predominantly of willows, gums and pines. There are several

residences located within the spray block.

Thirty-nine egg masses and 186 moths were recovered from this area in 1989. The origin of this infestation is not known, but may be related to hunting and fishing clubs in the area or associated with the forestry industry. This site received two applications of Bt at 20 BIU.

6. Roanoke Rapids, Northampton County. This site is a 150-acre island in the Roanoke River. It is located approximately one mile east of the city of Roanoke Rapids and is situated at the intersection of Interstate 95 and the Roanoke River (see map, Roanoke Rapids site). The site lies in Northampton County (the main channel of the river constitutes the county boundary). Interstate 95 bisects the island. The dominant tree species on the island include white oak, red maple, southern yellow pine, virginia pine, gum, and willow. No residences or structures exist on the island.

Eleven moths and ten egg masses were recovered from this site in 1989. Although the origin of this infestation is not known, it may be associated with interstate travel and/or commerce along Interstate 95. This site received two applications of Bt at 20 BIU.

7. Enfield, Halifax County. This 200-acre site is a swampy, wetland area located on both sides of County Road 1001 approximately two miles north of the town of Enfield in Halifax County. Dominant tree species include gum, river birch and willow. No structures or residences are located on this site.

Four egg masses and 135 moth were recovered from this site in 1989. The origin of this site is not known, although it may be related to traffic or to an earlier spot infestation located approximately six southeast of this site. This site received two applications of Bt of 20 BIU.

8. Scotland Neck, Halifax County. This 900-acre site is situated approximately two miles southwest of the town of Scotland Neck, Halifax County, and lies on either side of U.S. Highway 258 (see map, Scotland Neck site). Dominant tree species in the upland portion of this site include white oak, southern yellow pine, and ironwood. The eastern boundary of this spray block lies adjacent to Deep Creek; dominant tree species in this swampy, wetland portion of the spray block are gum, willow and river birch.

Nine hundred moths and 10,011 egg masses were recovered from this site in 1989. A large white oak tree in the center of this site was found to harbor several thousand egg masses. Although the origin of this infestation is not know, it may be related to the activities of a resident who makes periodic visits to New Jersey. Several residences exist in this spray block. This site received two application of Bt with follow up treatments to the core area with Bt and Demilin using ground equipment.

9. Grove Hill, Warren County. This 50-acre site is a rural, sparsely populated, forested area in northeastern Warren County (see map, Grove Hill site). This area is predominantly pine with mixed hardwoods. Gum and river birch are dominant along the creek in the center of this site. A portion of the area was clear cut in 1984.

On hundred and fifty male moths were captured at this site in 1989. An egg mass survey conducted in January, 1990 yielded three egg masses. The origin of this infestation is not known. No residences exist at this site. This site received two applications of the virus Gyp-Chek under a cooperative program with USDA-APHIS and U.S. Forest Service.





STATE OF CALIFORNIA  
DEPARTMENT OF FOOD AND AGRICULTURE  
PEST DETECTION/EMERGENCY PROJECTS

California Gypsy Moth Program - 1990

The California Department of Food and Agriculture maintains a statewide detection program for gypsy moth using trap densities of two traps per-square-mile in most residential and densely populated rural areas, and three traps per square mile in urban areas with high numbers of families moving from gypsy moth infested areas of the northeast. High risk sites such as campgrounds, recreational areas, mobile home parks, etc., are trapped at a minimum of one trap per site. Upon catching an adult gypsy moth, trap density is increased to 25 traps per-square-mile in a four-square-mile area around the find. In addition, incoming moving vans from gypsy moth infested areas of the East have their contents inspected upon arrival at their destination. If there are any signs of live gypsy moth eggs, larvae, or pupae, 25 (quarantine) traps are deployed in a square-mile area around the move-in site. If spent pupal cases and old egg masses are recovered, then a single (quarantine) trap is placed on the property.

Eradication treatment occurs when a breeding gypsy moth population is located. Evidence of a breeding population is as follows:

1. Male moth trap catches and one or more other life stages, such as egg masses, larvae, or pupae; or evidence of these life stages, such as cast skins, pupal cases or inviable egg masses.
2. Male moth catches followed by five or more male moths trapped the following year in a 400-meter radius (1/4 mile); or,
3. Viable egg masses, other than those found on objects recently transported from infested areas.

The boundaries of the treatment area are approximately one-quarter-mile radius (ground treatment) to one-half-mile radius (aerial treatment) around the core of the infestation, as determined by moth catches and/or egg masses. Other factors may alter the size or shape of the treatment area such as trapping single moths outside the core, natural barriers to the spread of the moth, the history of moth catches, and the method of treatment. Because of these variables, boundaries are drawn on a case-by-case basis.

The discovery of moths and egg masses in 1989 led to two limited treatment programs in the counties of Marin and Placer during the spring of 1990. The treatment of both sites entailed two applications of Dimilin at 14-day intervals. The applications were made by hydraulic ground spray rigs. There were 12 properties within the Marin County treatment area, and five properties involved in the Placer County treatment area. Post-treatment trapping was at a density of 49 traps per-square-mile in three square miles in Marin County, and six square miles in Placer County. 1990 post-treatment trapping was negative in both Marin and Placer County treatment areas.

All other 1989 moth capture sites (22), that did not lead to a treatment program, were trapped at a density of at least 25 traps per-square-mile over at least a four-square-mile area. Repeat captures occurred in Grass Valley, Nevada County, and La Mesa, San Diego County. All other 1989 gypsy moth capture sites were negative for 1990. These negative sites will revert to normal detection trapping levels for the 1991 season (see Attachment 1).

During 1990, the statewide gypsy moth detection and delimitation system had approximately 21,000 traps deployed throughout California. In total, 24 adult gypsy moths were captured in eight counties (see Attachment 2). The detection and delimitation trapping system captured 18 gypsy moths in six counties and the quarantine traps captured six gypsy moths in four counties. An egg mass survey was planned for the four multiple catch trap sites: La Mesa and Vista, San Diego County; Carmichael, Sacramento County; and Santa Barbara, Santa Barbara County. Egg mass survey is still in progress in Vista; however egg mass surveys in the other multiple catch sites have been completed. Gypsy moth evidence such as viable egg masses, larva, and pupal cast skins were found at Carmichael, Sacramento County; one female pupal case was found at La Mesa, San Diego County, and no gypsy moth evidence was found at the Santa Barbara County site. Treatment plans have not been made; however, treatment strategies are being discussed for Carmichael and La Mesa, where egg mass survey discovered additional gypsy moth evidence.

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE  
Pest Detection/Emergency Projects

SUMMARY - 1989/90 GYPSY MOTH TRAPPING ACTIVITY

COUNTY	CITY	1989 CAPTURES	1990 INTENSIVE TRAPPING RESULTS	PROPOSED 1991 TRAPPING LEVELS
Alameda	Berkeley	2	0	3/sq.mi.
Los Angeles	Chatsworth	1	0	3/sq.mi.
	Newhall	1	0	3/sq.mi.
	Sun Valley	1	0	3/sq.mi.
	Woodland Hills	1	0	3/sq.mi.
Marin	Fairfax	2	0	3/sq.mi.
	Novato	1	0	3/sq.mi.
	San Anselmo	2	0	3/sq.mi.
	San Rafael	3	0	3/sq.mi.
	Tiburon	17	0	49/sq.mi.
Nevada	Grass Valley	3	2	25/sq.mi.
Orange	Anaheim	1	0	3/sq.mi.
	Fullerton	1	0	3/sq.mi.
Placer	Roseville	3	0	49/sq.mi.
Sacramento	Carmichael	1	0	3/sq.mi.
San Diego	La Mesa	7	4	49/sq.mi.
	Valley Center	1	0	3/sq.mi.
San Joaquin	Manteca	1	0	2/sq.mi.
San Mateo	Menlo Park	1	0	3/sq.mi.
Santa Clara	San Jose	1	0	3/sq.mi.
Shasta	Cottonwood	2	0	3/sq.mi.
Tuolumne	Sonora	1	0	3/sq.mi.
Ventura	Thousand Oaks	2	0	3/sq.mi.

CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE  
Pest Detection/Emergency Projects

SUMMARY - 1990 GYPSY MOTH FINDS

COUNTY	<--ADULTS TRAPPED--> DETECTION QUARANTINE		TOTAL ADULTS	PROPERTIES WITH VIABLE EGG MASSES/ PUPAL CASES
LOS ANGELES	3	0	3	0
Diamond Bar (1)				
Lynwood (1)				
Long Beach (1)				
NEVADA	1	1	2	
Grass Valley (1,1)				
SACRAMENTO	0	3	3	0
Carmichael (3)				
SAN DIEGO	7	0	6	0
La Mesa (4)				
Mira Mesa (1)				
Vista (2)				
SAN JOAQUIN	0	1	1	
Stockton (1)				
SANTA BARBARA	4	0	4	0
Santa Barbara (4)				
SANTA CLARA	1	1	2	
San Jose (0,1)				
Los Altos Hills (1,0)				
SANTA CRUZ	2	0	2	
Aptos (1)				
Santa Cruz (1)				
	—	—	—	—
	18	6	24	0

08/08/90





## **1990 Green Mountain National Forest Gypsy Moth Suppression Project**

In the spring of 1990 the Green Mountain National Forest (GMNF) suppressed gypsy moth (GM) on approximately 3200 acres of the Middlebury District. The project was conducted jointly with the State of Vermont Division of Forests, Parks and Recreation. This was the first time the two agencies had collaborated on a suppression project. The Incident Command System (ICS) was also used for the first time to plan and implement the project. The objectives of the GMNF were to reduce defoliation to less than 30% and to lower egg mass (EM) densities below 1000 per acre. The Forest also decided to delay all harvests in the proposed treatment blocks.

The Middlebury Ranger District was sprayed on May 30, 1990 from 5:00 am to 10:00 am. All blocks were sprayed that day. At this time larval development was 17% firsts, 70% seconds, and 13% third instar. Prespray defoliation averaged 10% and EM counts ranged from 1100 to 5300 per acre. The aircraft used was a Piper Aztec equipped with 34,8008 flat fan nozzles. Foray 48B<sup>R</sup> was applied undiluted at a rate of 64 ounces and 24 BIU's per acre. Aircraft speed was 150 mph and the release height was 50 feet above the canopy and the swath width approximately 150 feet.

Post spray evaluations for defoliation and egg mass surveys were done in July and September respectively. Post spray defoliation averaged 15% in spray blocks and 70% in control blocks. Egg mass surveys showed the mean EM densities for all blocks to be less than 1000 per acre, however some isolated areas within the blocks had as high as 3300 EM per acre.

Overall the project satisfied its goals of reducing defoliation and EM densities. The project had many "firsts." The State of Vermont and GMNF felt that ICS was a useful tool and would use it again. The undiluted application of Foray 48B<sup>R</sup> at 64 ounces and 24 BIU per acre was also well received. Both groups benefited from the joint contract and the sharing of resources such as personnel and technical expertise.



1990 COOPERATIVE GYPSY MOTH SPRAY PROJECT  
DEFOLIATION ASSESSMENTS

INTRODUCTION

On 27 and 28 May, 7,514 acres were sprayed in Chittenden County at the request of the following municipalities: Burlington, South Burlington, Colchester, Essex (town and village), and Winooski. All spray blocks were treated once with Foray 48B (Bacillus thuringiensis var. kurstaki), applied undiluted by small, twin-engine, fixed wing aircraft at the rate of 24 Billion International Units (64 oz.) per acre. Larvae were at optimum development size (46% instar 1; 51% instar 2; 3% instar 3) for the Foray to be effective, but noticeable defoliation (average of 9%) had already taken place prior to treatment. Weather conditions on the days of spraying were excellent and no rain was received for at least 30 hours after treatment.

To evaluate defoliation, 10 to 30 oak trees per block (depending on block size) were selected and flagged prior to treatment, for a total of nearly 500 trees. These were individually rated from the ground (using binoculars) to estimate actual percent defoliation to the nearest five to 10 percent. Trees were randomly selected to represent a broad geographical representation of each block. Trees were rated on the day of treatment to estimate prespray defoliation and again in mid-July to estimate final defoliation. Not every spray block was rated for defoliation, but the majority of them, especially the larger blocks, were rated.

As a comparison to the spray blocks, five additional unsprayed areas that had high enough prespray egg mass counts to qualify for insecticide treatment, were assessed in the same way as the spray blocks. Thirty trees in each of these untreated blocks were used for defoliation estimates.

RESULTS AND DISCUSSION

Defoliation in town project spray blocks averaged 12 percent compared to 52 percent in the unsprayed areas. Defoliation on the days of spraying averaged nine percent. Thus, on average, only three percent additional defoliation took place after spraying.

Some moderate (30-60%) to heavy (over 60%) defoliation took place in some spray blocks, but in most blocks this was confined to scattered individual trees. These tended to be large roadside trees that were loaded with egg masses laid in 1989. On 19 July, 34 of the blocks were surveyed by helicopter to evaluate degree of foliage protection. Of the 5,661 acres aerially evaluated,

175 acres (3% of the area) had visible moderate to heavy defoliation. Most blocks looked good, but Suites and Lost Nation Blocks in Essex were largely (75-80%) defoliated, and Gentes (Essex), Edwards (Essex), Canyon Estates (Colchester), West Street (Essex), and Pinewood (Essex) had some areas of poor protection.

Trees selected on the ground, with some exceptions, were fairly representative of average defoliation in the block. In most cases, blocks that averaged above 15 percent defoliation received some heavy defoliation of scattered individual trees, with the following exceptions:

1. Gilbrook Block, (Winooski) - although a few of the rated trees were moderately defoliated, the block looks very good overall.
2. Porters Point (Colchester) - except for some edge trees that missed being sprayed, no heavy defoliation was reported.

A few blocks that had areas of poor foliage protection (as evaluated from the ground) are worthy of mention:

1. Pinewood Block (Essex) - the upper Skyline Drive/Forest Road area received heavy defoliation of scattered individual trees, with nearly complete defoliation on some trees.
2. Edwards Block (Essex) - many trees here received 55 to 60 percent defoliation.
3. Canyon Estates (Colchester) - a section along Colchester Road (Route 2A) received moderate to heavy defoliation. This was outside of the area where trees were evaluated for defoliation.

Even though there were a few problem areas, it is obvious that without insecticide treatment, most of the areas sprayed would have received much heavier defoliation.

All spray blocks will be surveyed this fall for postspray egg mass counts to determine population reduction and the need for any retreatment in 1991.

Ronald S. Kelley  
Forest Protection Specialist  
Vermont Department Forests, Parks & Recreation  
6 August 1990

STATE OF VERMONT  
1990 GYPSY MOTH SPRAY PROJECT  
Defoliation-Ground Ratings  
Spray Blocks

Block	Ave. % Defoliation	Range
BURLINGTON		
North Avenue	12.7	0-30
SOUTH BURLINGTON		
Airport	5.0	0-25
WINOOSKI		
Gilbrook	21.5	10-50
ESSEX		
Pinewood	16.8	0-50
Pinecrest	7.0	0-15
New England	5.0	5
Gentes	5.0	5
Edwards	23.9	5-65
Hillside	2.5	0-5
West Street	19.0	0-75
COLCHESTER		
Mallets Bay	22.8	5-50
Mallets Bay Extension	16.5	0-25
Town Farm	20.0	5-30
Trailer Park	11.3	5-20
Bayside	1.5	0-10
Clay Point	9.0	5-20
Oak Terrace	6.3	5-10
Pheasant Woods	23.4	5-50
Sunderland Woods	3.8	0-5
Camp Johnson	3.8	0-5
Canyon Estates	9.5	0-25
Porters Point	21.5	0-50
Creek Farm	10.0	5-10
Kenya Road	10.0	5-40
Davis 1	<u>7.5</u>	<u>5-20</u>

AVE. 12.1 BLOCK RANGE: 1.5-23.9

Prespray defoliation averaged 8.9% and ranged up to 30% per tree.

<u>Block</u>	<u>Ave. % Defoliation</u>	<u>Range</u>
UNTREATED CHECK BLOCKS		
Brigham Hill (Colch/Essx)	41.0	15-90
Sandbar (Milton)	42.8	30-60
Essex Nursery	79.2	30-100
Raymond Road (Colch)	21.0	10-60
I-89 (Colch)	<u>77.0</u>	<u>60-90</u>
AVE. 52.2 BLOCK RANGE: 21.0-79.2		

Prespray defoliation averaged 9.9% and ranged up to 40% per tree.





Report of Laboratory and Field  
Pesticide Testing Activities - APHIS - S&T

Win McLane  
USDA, APHIS, S&T  
Otis Methods Development Center  
Building 1398  
Otis ANGB, MA 02542

Laboratory

A number of registered and experimental pesticides were tested in the laboratory during the past year. *Bacillus thuringiensis* (Bt), insect growth regulators, neem products, feeding stimulants and pheromone beads were evaluated.

ABG-7022, an experimental carrier for mainly oil base formulations, was tested extensively and was found to enhance the activity of Dipel 8L and Dipel powder formulations. Faster kill was observed when using the ABG 7022 formulation. Residual activity continued for 9 or more days, similar to that of Foray 48B.

TABLE 1. Percent mortality of 2nd instar gypsy moth larvae and seedling defoliation following exposure to oak seedlings treated with Bt.

Material	BIU gal/acre	Percent mortality				Percent Defoliation	
		2 days	4 days	6 days	10 days	2 days	4 days
Dipel 2x + ABG-7022	14.52	73	97	100		1	1
Dipel 2x + H2O	14.52	4	11	68	99	30	40
Foray 48B	14.52	38	79	100		3	6
Thuricide 32LV	14.52	31	75	97	99	3	7
Dipel 8L	14.52	10	20	83	97	20	30
Dipel 2x + ABG-7022	7.26	37	47	90	98	7	13
Dipel 2x + H2O	7.26	2	4	17	35	34	52
Foray 48B	7.26	19	50	90	94	5	8
Thuricide 32LV	7.26	10	42	97		13	14
Dipel 8L	7.26	0	1	3	19	44	75
Dipel 2x + ABG-7022	3.63	38	65	96	99	5	14
Dipel 2x + H2O	3.63	0	3	14	27	46	100
Foray 48B	3.63	11	31	95	100	18	30
Thuricide 32LV	3.63	14	67	94	99	9	9
Dipel 8L	3.63	0	3	13	35	48	100
Control (ABG-7022)	Carrier	1	1	2	2	58	100

TABLE 2. Percent larval mortality and seedling defoliation after exposure of 2nd instar gypsy moth larvae to seedlings treated with various dosages of Dipel 8L and ABG-7022.

Formulation	Dosage BIU/gal/acre	Percent mortality			Percent defoliation		
		2 day	4 day	8 day	2 day	4 day	8 day
8L + ABG-7022	1	42	57	75	10	20	26
8L + Water	1	0	0	2	90	100	
8L + ABG-7022	2	45	69	94	5	11	12
8L + Water	2	1	1	3	77	99	99
8L + ABG-7022	4	47	78	98	3	7	8
8L + Water	4	0	1	5	64	91	91
8L + ABG-7022	6	57	85	98	2	5	6
8L + Water	6	2	2	35	27	71	73
8L + ABG-7022	8	58	84	94	3	6	12
8L + Water	8	1	3	34	36	92	92
Control	--	0	0	1	80	98	98

TALBE 3. Percent mortality of 2nd instar gypsy moth larvae after exposure to oak seedlings treated with a number of Bt formulations at 12 BIU/gallon/acre and exposed to natural sunlight.

Material	Percent mortality											
	Day 0 <sup>1/</sup>			Day 2			Day 7			Day 9		
	4 day <sup>2/</sup>	8 day	12 day	4 day	8 day	12 day	4 day	6 day	12 day	4 day	8 day	12 day
MYX-2284	34	92	98	43	95	100	12	17	25	0	11	17
MYX-2728	5	16	30	85	100		4	17	25	0	9	12
MYX-2728-168	18	91	99	14	97	100	0	8	24	0	3	3
MYX-7275	3	26	55	6	59	74	1	3	6	0	1	2
MYX-7275M	29	75	91	37	97	100	0	3	5	2	4	6
MYX-8242	86	100		45	99	100	2	19	24	5	17	18
FORAY 48B	48	93	100	73	100		10	22	28	10	36	47
Dipel 8L	9	39	59	19	67	84	0	1	2	1	3	3
ABG-7022 + Dipel 2X	86	94	98	61	93	100	41	56	65	14	40	46
ABG-7022 + Dipel 2X + Emul	72	91	98	72	96	98	28	54	70	0	11	16
CONTROL	0	1	2	0	2	5	0	0	1	0	0	1

<sup>1/</sup> Days of outside exposure

<sup>2/</sup> Days larvae exposed to plants

As a result of favorable laboratory data with ABG-7022 field tests were conducted in Pennsylvania. Field results are reported later in this report.

CGA-184699, an insect growth regulator from Ciba-Geigy was screened in the laboratory and compared to Dimilin. CGA-184699 was as effective as Dimilin 25W at dosages presently registered for use against gypsy moth. Dimilin was more effective at very low dosages (0.0156-0.0078 oz. AI/acre). Both materials experienced little wash-off when exposed to heavy rainfall.

At this time there are no plans to do field work with CGA-184699.

TABLE 4. Percent larval mortality and seedling defoliation following gypsy moth larvae exposure to red oak seedlings treated with CGA-184699 and Dimilin 25W at various dosages.

Material	lbs.AI Gal/acre	Percent mortality			Percent defoliation
		4 day <sup>1/</sup>	8 day	11 day	4 day
CGA-184699	.0625	26	98	100	98 <sup>2/</sup>
Dimilin 25W	"	13	100	--	81
CGA-184699	.0156	22	97	100	99
Dimilin 25W	"	18	100	--	100
CGA-184699	.0039	19	96	100	100
Dimilin 25W	"	20	100	--	78
CGA-184699	.00097	11	67	95	93
Dimilin 25W	"	19	98	100	85
CGA-184699	.00048	6	17	51	90
Dimilin 25W	"	24	89	97	97
CGA-184699	.00024	1	7	42	91
Dimilin 25W	"	4	53	90	99
Control	--	0	1	1	100

<sup>1/</sup> Days after original exposure to treated seedlings

<sup>2/</sup> Larvae changed to artificial diet as seedlings were near complete defoliation

TABLE 5. Percent larval mortality and seedling defoliation following gypsy moth larvae exposure to red oak seedlings treated with CGA-184699 and Dimilin 25W at .0625 lbs. AI/gallon/acre then exposed to rainfall.

Material	Inches rain	Percent mortality		Percent defoliation
		4 day	<sup>1/</sup> 7 day	4 day <sup>2/</sup>
CGA-184699	--	7	100	88
"	1.0	2	100	94
"	2.0	4	100	74
"	3.0	16	100	86
"	5.0	20	100	66
Dimilin 25W	--	3	100	82
"	1.0	3	100	86
"	2.0	7	100	86
"	3.0	9	100	88
"	5.0	9	100	78
Control	--	0	2	89

<sup>1/</sup> Days after original exposure to treated seedlings

<sup>2/</sup> Larvae changed to artificial diet as seedlings were near complete defoliation

CGA-237218, a Ciba-Geigy formulation of (Bt) was tested and found to be more effective than Dipel 8L and less effective than Dipel 8AF and Foray 48B.

A number of Ecogen and Mycogen (Bt) samples were tested and found to be less effective than the presently registered formulations.

Foray 75 BFC (75 BIU/gal) was tested and found to be as effective as Foray 48B against gypsy moth larvae.

Three formulations of Futura (Bt) from Chemagro Limited were tested in the laboratory. Futura XLV was the most effective of the formulations tested with activity being slightly less than that of Dipel 8AF and Foray 48B. The XLV-HP and O formulations weathered poorly. Futura is registered in Canada and used against budworm.

Margosan-O (neem) from W. R. Grace was tested in the laboratory and found to be effective against 2nd instar gypsy moth larvae. Previously tested formulations of neem were found to have little effect. Most mortality occurred 10 or more days after exposure time. When exposed to 0.10 inches of rain 4 hours after treatment most material washed off the oak foliage.

Margosan-O was field tested in 1990 against gypsy moth in Pennsylvania. Results are reported later in this report.

TABLE 6. Percent larval mortality following exposure to oak seedlings treated with Margosan-O at various dosages.

Dosage/Acre lbs.AI/gal	Oz./Form acre	Percent mortality			
		10 days	16 days	20 days	25 days
.0054	32	78	99	100	
.0027	16	23	49	88	99
.00135	8	20	34	75	93
.00067	4	15	31	47	73
.00033	2	11	21	29	51
.000168	1	0	3	4	15
.000084	.5	1	9	13	29
.000042	.25	1	4	18	31
Control		1	2	7	7

TABLE 7. Percent larval mortality following exposure to oak seedlings treated with Margosan-O at various dosages and exposed to rainfall.

Dosage/Acre lbs.AI/gal	Oz/Form acre	Inches rain	Percent mortality			
			8 days	14 days	20 days	25 days
.216	128	--	10	91	99	100
"		.10	4	9	42	64
.0108	64	--	3	60	92	100
"		.10	2	3	5	25
.0054	32	--	8	60	93	100
"		.10	0	0	0	4
.0027	16	--	8	36	90	96
"		.10	2	3	12	29
Control	--	--	0	0	0	0
"		.10	0	0	0	0

Coax, a feeding stimulant from CCT Corporation, was tested in the laboratory against 2nd instar gypsy moth larvae. Tender oak seedlings were sprayed with Coax and then exposed to gypsy moth larvae for various amounts of time. Percent defoliation of seedlings was recorded to determine effectiveness.

Data indicate increased feeding on plants treated with Coax at high dosages. Tests have not been conducted using Coax in a Bt formulation.

TABLE 8. Average percentage of defoliation for 3 replications of each treatment after various exposure times.

Material tested	Average percent defoliation		
	3 hours	7 hours	19 hours
Coax (1.0 lbs/acre)	12	27	87
Coax (100%/gal/acre)	37	55	100
ABG-7022	11	18	47
ABG-7022	8	22	72
Dipel 8L - 16 BIU/gallon/acre	9	16	43
Dipel 8AF - 16 BIU/gallon/acre	4	4	8
Foray - 16 BIU/gallon/acre	10	10	10
Thuricide 32LV - 16 BIU/gallon/acre	3	4	8
Condor OF - 16 BIU/gallon/acre	9	9	12
Control - untreated	18	40	73

A second test consisted of 10 replications and test insects were given a choice of what treated diet they preferred to feed on. A treated and untreated control were placed in each dish with 3 newly moulted 2nd instar gypsy moth larvae for 24 hours.

TABLE 9. Average percentage of defoliation for 10 replications of each treatment after 24 hours

Material tested	Average percent defoliation	
	Treatment	Control
Coax (1.0 lbs/acre) -- Control untreated	45	11
Coax (100%/gal/acre) -- Control untreated	40	15
ABG-7022 No Emul -- Control untreated	8	19
ABG-7022 Emul -- Control untreated	11	45
Dipel 8L - 16 BIU/gal/acre -- Control untreated	2	31
Dipel 8AF - 16 BIU/gal/acre -- Control untreated	1	8
Condor OF - 16 BIU/gal/acre -- Control untreated	5	7
Thuricide 32LV - 16 BIU/gal/acre -- Control untreated	1	2
Foray 48B - 16 BIU/gal/acre -- Control untreated	2	4
Control untreated -- Control untreated	11	26

A number of stickers were tested with an experimental formulation of gypsy moth pheromone. RA 1990, Rhoplex B60A, Gelva 2397 and Bond were the most effective stickers when used with Agri-Sense Beads. An experimental field test was conducted in 1990 with the beads and RA 1990 sticker.

### Field

Field tests were held in Pennsylvania, North Carolina, West Virginia, Tennessee and Virginia during 1990. All treatments were made by Animal and Plant Health Inspection Service pilots and aircraft from their aircraft operation center, Moore Air Base, Mission, Texas. We thank them for their continued support of Science and Technology's activities.

In Pennsylvania, 10 experimental formulations were tested on field plots (50 acres each) and one used as a pilot study (500 > acres).

TABLE 10.

#### MATERIALS FIELD TESTED IN 1990 - APHIS, S&T

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Margosan-O	4 oz/128 oz/acre
Margosan-O	16 oz/128 oz/acre
Dimilin 25W	.03 lbs. AI/128 oz/acre
Dimilin 2F (special)	.03 lbs. AI/32 oz/acre
Dimilin 2F (special)	.03 lbs. AI/16 oz/acre
Dipel 8L + ABG 7022	20 BIU/80 oz/acre
Dipel 8L + ABG 7022	10 BIU/40 oz/acre
Dipel 8L + oil	20 BIU/80 oz/acre
Dipel 8AF + water	20 BIU/80 oz/acre
Dipel W/P + ABG 7022	20 BIU/80 oz/acre
Dipel W/P + ABG 7022	10 BIU/40 oz/acre

---

All applications were made with a Cessna Ag-truck aircraft equipped with conventional spray boom and flat fan spray tips. All larvae were early 2nd instar and foliage was approximately 30 percent expanded at time of treatment. All treatments except three were replicated four times.

Treatment evaluation consisted of pre- and post-spray egg mass counts; larvae under burlap counts, defoliation estimates, aerial evaluation of defoliation and a general observation rating.

For the 3rd year, low volume applications of Dimilin 2F (Special) were tested and compared to a standard Dimilin 25W treatment. Dimilin 2F (Special) was pilot tested at 0.03 lbs. AI/32 oz./acre. Gypsy moth egg mass counts averaged 8,775 per acre and there was approximately 10 percent defoliation at the time of treatment.

A general population collapse occurred in all spray and control plots. However, based on defoliation estimates and general observations (ratings), the low volume applications were as effective as the standard Dimilin 25W treatments. The 500 acre pilot study plot (0.03 lbs. AI/32 oz./acre) looked excellent. There was no obvious difference between the pint and quart treatments.

TABLE 11.

FIELD STUDIES WITH DIMILIN IN 1990 - APHIS

<u>FORMUL.</u>	<u>DOSAGE/RATE</u> (lbs.AI/_oz/A)	<u>%</u> <u>DEFOL.</u>	<u>RATING</u>	<u>POP.</u> <u>CHANGE</u>
25W	.03/128 oz.	21	8	- 99.7
2F (SP)	.03/32 oz.	15	8	-100
2F (SP)	.03/16 oz.	23	8	- 99.9
CONTROL		50	3	- 94 + 12 13

TABLE 12.

LOW VOLUME DIMILIN STUDIES 1988 - 1990 APHIS

<u>FORMUL.</u>	<u>DOSAGE/RATE</u> (lbs.AI/ oz/A)	<u>%</u> <u>DEFOL.</u>	<u>POP.</u> <u>CHANGE</u>
2F (SP) 1988	.03/32 oz.	<5	- 99
2F (SP) 1989	.03/32 oz.	5	- 99
2F (SP) 1990	.03/32 oz.	15	-100
2F (SP) 1988	.03/16 oz.	<5	- 94
2F (SP) 1989	.03/16 oz.	5	- 99
2F (SP) 1990	.03/16 oz.	23	- 99.9
25W 1988	.03/128 oz.	<5	- 95
25W 1989	.03/128 oz.	5	- 98
25W 1990	.03/128 oz.	21	- 99.7

TABLE 13.

LOW VOLUME DIMILIN STUDIES 1988 - 1990      APHIS

<u>FORMUL.</u>	<u>DOSAGE/RATE</u> (lbs. AI/_oz/A)	<u>%</u> <u>DEFOL.</u>	<u>POP.</u> <u>CHANGE</u>
<u>1988</u>			
25W	.03/128 oz.	<5	- 95
2F (SP)	.03/64 oz.	<5	- 99
2F (SP)	.03/32 oz.	<5	- 99
2F (SP)	.03/16 oz.	<5	- 94
CONTROL		11	+511
<u>1989</u>			
25W	.03/128 oz.	5	- 98
25W	.015/128 oz.	5	- 98
2F (SP)	.03/32 oz.	5	- 99
2F (SP)	.015/32 oz.	5	-100
2F (SP)	.03/16 oz.	5	- 99
CONTROL		25	- 31
<u>1990</u>			
25W	.03/128 oz.	21	- 99.7
2F (SP)	.03/32 oz.	15	-100
2F (SP)	.03/16 oz.	23	- 99.9
CONTROL		50	- 94

Based on these data and the fact that Dimilin 4F is now registered, 0.03 lbs. AI/32 oz./acre treatments of Dimilin 4F (Special) should be available for limited operational use in 1991. A pilot study (500 > acres) should be conducted with Dimilin 4F (Special) at 0.03 lbs. AI/16 oz./acre in 1991. Rates of 8 and 12 ounces per acre should be tested on 50 acre field plots in 1991.

Margosan-O, a neem formulation, was field tested (50 acre plots) at 4 and 16 ounces of formulation in 128 ounces of water per acre. Three percent Triton 1956 sticker was used in the formulation. All mixing was done in the aircraft. Average egg masses were 3,923 per acre.

Although some foliage protection was achieved, results were generally poor based on our general observation rating. Poor results may have been due to ultraviolet light degradation and/or washoff. Triton 1956 gives limited protection from washoff, however, no rain occurred on treated plots until 2.5 days following treatment. The effects of UV light on Margosan-O have not been investigated.

Additional laboratory work will be done with Margosan-O in an attempt to determine why it did not perform more efficaciously in the field. Other stickers will be tested so a more effective one may be available for use with this product.

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TABLE 14.

FIELD STUDIES WITH MARGOSAN-O IN 1990 - APHIS

<u>FORMUL.</u>	<u>DOSAGE/RATE</u>	<u>% DEFOL.</u>	<u>RATING</u>	<u>POP. CHANGE</u>
S/C	16 oz/128 oz/A	27	5	-93
S/C	4 oz/128 oz/A	31	5	-92
CONTROL				-94

---

An experimental carrier (ABG-7022) was tested in the field with Dipel 8L and Dipel technical powder. Treatments were compared to Dipel 8AF and Dipel 8L with oil.

Laboratory test results using this carrier with a number of Bt formulations were outstanding. However, field test results were no better than those with Dipel 8AF and only slightly better than with Dipel 8L and oil. The plots treated with Dipel technical powder and ABG-7022 appeared to have the best control based on defoliation and general observations. Overall there was little difference between any of the treatments.

Over the past two years, there has been a shift to nearly all aqueous Bt formulations for use against gypsy moth. Therefore, it is not necessary to continue work with oil formulations of Bt for gypsy moth control. However, ABG-7022 can be used with aqueous Bt material. Field testing should continue with ABG-7022 (Emul) and aqueous Bt formulations. Tests should be in areas where the gypsy moth population is healthy and building with maximum egg mass counts of 1,000 per acre. In 1990, egg mass counts averaged 5,835 per acre in Bt treatment plots.

TABLE 15.

FIELD STUDIES WITH BACILLUS THURINGIENSIS BT IN 1990 - APHIS

<u>FORMULATION</u>	<u>DOSAGE/RATE</u>	<u>LARVAE</u>	<u>DEFOL.</u>	<u>RATING</u>	<u>CHANGE</u>
		(BIU/oz/A)			
Dipel 8L+ ABG 7022	20/80 oz	48	26	7.3	-92
Dipel 8L+ ABG 7022	10/80 oz	94	31	6	-90
Dipel 8L+ oil	20/80 oz	59	30	6.3	-92
Dipel 8AF+ water	20/80 oz	33	27	7.3	-93
Dipel Tech/ P+ABG 7022	20/80 oz	42	24	7.5	-89
Dipel Tech/ P+ABG 7022	10/40 oz	27	15	9	-86
CONTROL		321	50	3	-94

In North Carolina and West Virginia Gypchek<sup>®</sup> was applied to isolated gypsy moth infestations in an attempt to eradicate them. At both locations, two applications were made two days apart with  $1 \times 10^{12}$  polyhedral inclusion bodies (PIB) in two gallons per acre. The material was applied with the APHIS Cessna Ag-truck aircraft using 8006 flat fan nozzle tips. All mixing and loading was done by Forest Service personnel (Dr. Podgwaite, Dr. Reardon and H. Hubbard).

The Warren County-Grove Hill site in North Carolina was treated with two applications of Bt in 1989 followed by a four square mile grid trapping program (25 traps/1 sq. mile). In this trapping grid, a moss trapping grid (9 traps/acre) was established and 126 male moths were captured. An extensive egg mass survey turned up two large viable gypsy moth egg masses. The 50+ acre treatment area 507 was centered over the egg masses. In 1990 a four mile square grid (25 traps/1 sq. mile) was again used to evaluate the treatment. Trees with burlap were also used to evaluate gypsy moth larvae populations.

No male moths were trapped within the treated area and no larvae were found under burlap. Two male moths were captured within the four square mile grid outside the treatment area. It would appear that this treatment was effective in eliminating gypsy moth larvae from the treatment area.

An isolated infestation of gypsy moth was treated with Gypchek near Athens, West Virginia. Although isolated, this infestation was heavy with egg masses. In a core area of four acres, egg mass counts were approximately 2500 per acre and

moderate defoliation had occurred during 1988 and 1989. No life stages were found outside the generally infested area of 10 to 15 acres.

Approximately 60 acres were treated on May 1st and a second application was applied on May 3rd. Coverage was excellent based on spray card data. Foliage at time of treatment was approximately 10 percent expanded. Although post-spray trapping and egg mass data has not been completely analyzed, larvae counts under burlap and general observations as well as defoliation estimates indicate good control. Some larvae were still present under burlap 6-8 weeks following treatment so eradication was not achieved.

The Gypchek treatment results were encouraging and will result in continued work on isolated infestations in 1991.

Gypsy moth pheromone (Disrupt II) was applied to acreage in Tennessee and Virginia. An experimental formulation of pheromone from Agri-Sense was tested in the field in Virginia. Formulation and application problems were encountered with the Agri-Sense beads resulting in cancellation of most of the scheduled work.

Additional laboratory work will be conducted with the beads and another field experiment will be attempted in 1991.





# UTAH GYPSY MOTH ERADICATION PROGRAM

## 1990 GYPSY MOTH REPORT

STEVE MUNSON

USDA FOREST SERVICE - FOREST PEST MANAGEMENT

Since the gypsy moth was first detected in July 1988, treatment and detection efforts have continued to expand as gypsy moth populations have been discovered in remote areas within the Wasatch mountains of Utah. In May 1989, 1190 acres were treated in the Mt. Olympus Cove area of Salt Lake City. As new populations were discovered during the 1989 detection and delimitation survey, the treatment area expanded in 1990 to include 13 blocks encompassing 20,064 acres in three counties (Davis, Utah and Salt Lake).

### 1990 Eradication Program

The only egg masses found during the fall 1989 egg mass survey were in the Mt. Olympus Cove spray block. All block boundaries were based on male moths captured during the 1989 flight period. All multiple catches and/or clusters of traps with single catches were placed within 1990 treatment block boundaries. Isolated single catches were often not included in spray block boundaries.

Aerial applications of Bacillus thuringensis, (Bt) were applied over the 20,064 acres in 1990. Each spray block (Table 1) was treated three times at 5-7 day intervals. Aerial application was made using three rotary wing aircraft, one Hiller 12E Soloy and two Bell 206B3's. All aircraft were equipped with four electronic rotary atomizer Beecomist nozzles calibrated to deliver 64 oz. per acre. Foray 48B at 24 BIU's was applied neat for all applications. Application costs, which includes the cost of the Bt and aerial application was \$9.23 per acre. Total project costs are approximately 1.1 million which, based on 60,072 acres treated, represents \$18.31 per acre.

Mass trapping was conducted within residential sections of each spray block. Approximately 2200 traps were placed within these residential sites. Preliminary estimates of the cost of trap placement and retrieval for mass trapping is \$5.06 per trap.

Detection trapping was conducted by APHIS personnel, using the new detection trapping guidelines developed by APHIS, 169 detection traps were placed throughout the state. No moths were captured in the detection survey.

Approximately 6,000 traps were placed in the delimitation survey within and surrounding the 1990 spray blocks. Of these, 2,000 traps were placed on Forest Service land in mountainous terrain. This represents an increase of 1,500 traps compared to the 1989 delimitation survey in this type of terrain. Only 5 percent of the traps placed in the mountains were listed as missing in 1990, compared to 30 percent listed as not found in 1989. In 1990, 527 moths were caught in the delimitation traps. Of these, 286 moths were captured outside of the treatment blocks. Most of the increase is due to additional traps placed in remote terrain and the high percentage of traps retrieved. Within the treatment blocks only 241 moths were captured compared to 2,239 positive catches in 1989 (Table 2).

In 1991, 14 blocks totaling 29,925 acres will be treated in a four county area (Davis, Salt Lake, Utah and Summit) of northern Utah (Table 3). B.t. at 24 BIU's will be applied neat in 3 applications spaced 5-7 days apart.

Table 1. 1990 Spray Block Acreage

Block #	Non-Federal	Federal		Total Federal	Total Block
		Forest	Wilderness		
DA1	5045	2317	0	2317	7362
SL1	1936	1124	483	1607	3543
SL2	72	0	0	0	72
SL3	102	79	0	79	181
SL4	966	320	0	320	1286
SL5	41	10	0	10	51
SL6	0	0	287	287	287
SL7	6	95	18	113	119
SL8	82	29	164	193	275
SL9	478	148	0	148	626
SL10	167	328	60	388	555
SL11	213	0	5	5	218
UT1	1803	3686	0	3686	5489
TOTAL	10911	8136	1017	9153	20064

Table 2. Total Number of Male Moths Per Treatment Block.  
1989 - 1990

Spray Block Area	1989	1990	Percent
SL1 - Millcreek	490	199	60
SL2 - Mt. Aire	6	0	100
SL3 - Lambs Canyon	9	0	100
SL4 - Hatch Canyon	10	0	100
SL5 - Little Mtn.	5	0	100
SL6 - Tolcat	9	3	66
SL7 - Lower Big Ctn.	7	0	100
SL8 - Upper Big Ctn.	6	0	100
SL9 - Top of the World	66	12	81
SL10 - Little Ctn.	20	3	85
SL11 - Bells Canyon	7	0	100
DA1 - Bountiful	703	15	98
UT1 - Provo	901	9	99
Total	2,239	241	90

Table 3. 1991 Spray Block Acreage

Block #	Block Name	Acres by Ownership		Total Acres/Block
		Federal	State/Private	
DA1	Parrish Creek	2950	539	3489
DA2	Mueller Park	2842	1851	4693
SL1	Red Butte	989	217	1206
SL2	Burr Fork	6	166	172
SL3	Alexander Creek	440	1640	2080
SL4	Mt. Dell	63	362	425
SL5	MillCreek	4200	1788	5988
SL6	Heughs Canyon	389	233	622
SL7	Knudsens Corner	0	72	72
SL8	Deaf Smith	1313	806	2119
SU1	Big Bear Hollow	0	507	507
UT1	Vivian Park	2479	2860	5339
UT2	Hope Campground	1205	1107	2312
UT3	Squaw Peak	811	90	901
TOTAL		17,687	12,238	29,925



# STATE OF IDAHO

SUMMARY REPORT OF 1990  
GYPSY MOTH  
ERADICATION AND SURVEY EFFORTS

with a brief history  
of gypsy moth related activities  
from 1974 to 1989

by

R. LADD LIVINGSTON

Idaho Department of Lands  
P.O. Box 670  
Coeur d'Alene, ID  
83814-0670

REPORT: IDL 90-7  
October 1990



STATE OF IDAHO  
SUMMARY REPORT OF 1990  
GYPSY MOTH  
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Coeur d'Alene, Kootenai Co., had one urban spray block of 25 acres while Sandpoint, Bonner Co., had 2 urban spray blocks of 10 and 25 acres and a rural block of 1000 acres. Each site received three aerial applications of Bt at 7 to 10 day intervals. Spraying began on May 9, and ended on June 6, 1990.

The spray aircraft was a Hiller-Soloy 12E single-rotor, turbine-engine helicopter with a 140-gallon tank. The spray boom was 33 feet long with six Beacomist Model 360A electronic rotary atomizer nozzles. The three nozzles on each side of the boom were spaced 21 inches apart with the inside nozzle 4.5 feet from the center of the aircraft.

We did not have a large enough larval population to measure pre and post spray densities so our measurement of success was in the pheromone mass trapping effort.

MASS TRAPPING

A mass trapping program covering the aerial treatment areas was implemented as a follow-up to the insecticide treatment using a density of 9 traps per acre in the urban sites of both Coeur

d'Alene and Sandpoint, and 5 per acre in the rural setting. A total of 3268 traps were used in this effort.

## RESULTS

NO MOTHS WERE CAUGHT IN ANY OF THE TREATED AREAS IN 1990.

### PHEROMONE SURVEYS

#### DETECTION SURVEY

The state wide detection survey was conducted by the Idaho Department of Lands, the Idaho Department of Agriculture, and the USDA Forest Service, Regions 4 and 1. Traps, pheromone baits and cost share funding were provided by APHIS, PPQ.

The Idaho detection survey is divided into three geographical regions of responsibility: northern Idaho covered by the Idaho Department of Lands, southwestern Idaho covered by the Idaho Department of Agriculture, and southeastern Idaho covered by the USDA Forest Service Region 4, Boise Field Office. The Forest Service Region 1, Forest Pest Management office Coeur d'Alene placed traps in NFS campgrounds in northern Idaho.

All detection trapping is done at a minimum trap density of 4 per square mile. The traps are checked twice during the peak of the flight season so that we can put out delineation traps that same season if moths are found.

In each of the three geographical survey regions the work is further subdivided into towns and cities or rural areas that are trapped on three different schedules. Priority 1 areas are trapped every year. These include those cities where gypsy moths have been found, or those with universities, military bases, government installations, or significant industry where we anticipate a high number of families moving in each year. Priority 2 and 3 areas, which are determined by population size, are surveyed every other year or every third year, respectively. Since many people that move into Idaho choose rural areas in which to live, we also survey these sites on a schedule that corresponds to that of the closest city or town. We also monitor the number of families moving into Idaho from gypsy moth infested states and if a city or area reaches a threshold in a year's time we will conduct a survey the next trapping season regardless of the original schedule.

## DETECTION RESULTS

In 1990 a total of 5640 detection traps were placed, 4493 in North Idaho, 614 in South West Idaho and 533 in South East Idaho. A total of 4 gypsy moths were found in these traps; 1 in a KOA campground in Idaho Falls (SE Idaho), and 3 in a single trap in the small town of Dover (N Idaho), approximately 1.5 miles south of the large rural aerial spray block near Sandpoint.

## DELINEATION SURVEY

The delineation trapping, which is conducted by the Idaho Department of Lands, is done at a minimum of 36 traps per square mile. In 1990 five areas were trapped at the delineation density using a total of 358 traps. These sites were: In southeastern Idaho, portions of Idaho Falls (157 traps) and Pocatello (100 traps) where moths were found in the 1989 detection survey; in northern Idaho adjacent to the urban spray areas of Coeur d'Alene (12 traps) and Sandpoint (16 traps), and surrounding the spot in Dover (73 traps) where the three moths were found during the flight season in a 1990 detection trap.

## DELINEATION RESULTS

Two moths were found in the delineation survey. These were in Idaho Falls in the center of the area where six moths were found in 1989.

## FUNDING

This project was funded by the Idaho Department of Lands with cooperative cost share suppression funds being provided by the USDA Forest Service, Region 1, and the USDA-Animal and Plant Health Inspection Service. Cost per acre for the contract spraying was \$89.28/acre and \$26.20/acre for mass trapping.

## PUBLIC INFORMATION

An information effort was conducted to inform and educate the public about the pest, the need to control it, the pesticide to be used and to ask for input relative to the project proposal. An environmental assessment was prepared and distributed to many individuals, local, state and federal agencies and to environmental and other interest groups for comment. Public meetings were held in Coeur d'Alene and Sandpoint. Overall consensus was favorable for the spray project.

Numerous articles appeared in local newspapers throughout the time of the entire program. Presentations were also given to the County Commissioners for both Kootenai and Bonner counties. A toxicology profile for the Bt pesticide used was sent with a cover letter explaining the project to all physicians in both Coeur d'Alene and Sandpoint.

Fliers announcing the first aerial application of insecticide were distributed to residents within the project areas the evening prior to the first treatment. Also, phone calls were made prior to each treatment to individuals who had expressed special concerns or needs.

### DISCUSSION

We feel the spray project and the mass trapping were successful. We have not yet looked for egg masses in Dover and Idaho Falls where the moths were found in the detection or delineation surveys. However, the results of this effort will help determine the need for spraying next year. The minimum control effort in 1991 is anticipated to be mass trapping around the two sites.

A BRIEF HISTORY OF GYPSY MOTH and RELATED ACTIVITIES IN IDAHO  
FROM 1974 to 1989 ..

1974 - 1985

Detection trapping in Idaho started in 1974 when the Idaho Department of Lands placed traps in all of the rest stops, campgrounds, state parks and tourist attraction sites throughout the state. This effort continued through 1983 when it was turned over to the Idaho Department of Agriculture with limited participation by the Idaho Department of Lands.

1986-1987

In 1986 the responsibility for the state-wide program was returned to the Idaho Department of Lands.

The gypsy moth was first detected in Idaho in 1986 when one male moth was caught in a pheromone-baited survey trap at Sandpoint. In 1987, 35 moths were caught, 22 at Sandpoint, 11 at Coeur-d'Alene, and one each at Lewiston and Cascade.

1988

In the spring of 1988 an egg mass survey was conducted (eggs deposited in 1987) with 1,440 residential properties being searched in Coeur d'Alene and 1,170 in Sandpoint. Forty-four egg masses were found in Sandpoint and three in Coeur d'Alene. A total of 4 properties in Coeur d'Alene and 21 in Sandpoint were found to have evidence of various gypsy moth lifestages.

In an effort to reduce the population as much as possible, a ground spray program was initiated in May of 1988. Orthene, an organic phosphorus insecticide, was used on ornamental trees, and Dipel a biological insecticide containing the bacterium Bacillus thuringiensis, Bt, was applied to fruit trees. A total of 23 trees in Coeur d'Alene and 68 trees in Sandpoint were treated. Each tree was sprayed three times.

Summer 1988 pheromone trap and fall egg mass surveys revealed that the gypsy moth was still present in both towns. In Coeur d'Alene

87 male moths were caught and 2 egg masses located. In Sandpoint 334 male moths were caught and 32 egg masses located. A direct comparison of pheromone trap catches between 1987 and 1988 cannot be made as a grid system of trap placement covering all of the infested area was used for the first time in 1988. This was also the first year that the grid system was used for the detection trapping in urban areas throughout the state.

## 1989

In a fall 1988 evaluation of the gypsy moth situation, it was the consensus of the Idaho Department of Lands, the USDA Forest Service, the USDA-Animal and Plant Health Inspection Service, and the Idaho Department of Agriculture that the gypsy moth was established in Sandpoint and Coeur d'Alene and that an eradication effort should be initiated in 1989.

In preparation for this project, an environmental assessment was prepared addressing several options, public meetings were held, news releases and general information was provided to newspapers and radio and television stations of the area, and general information covering the gypsy moth and announcements for the public meetings were hand-delivered or sent to all residents within the proposed treatment areas.

After reviewing the situation and receiving public comment, the Idaho Board of Land Commissioners on May 1, 1989, authorized implementation of plans to eradicate the gypsy moth from Idaho.

The 1989 treatments included three aerial applications of Dipel 8L, a biological insecticide with Bacillus thuringiensis (Bt) to 110 acres in Coeur d'Alene, and to 270 acres in Sandpoint, and implementation of a mass trapping program as a follow-up to the insecticide treatment. Intensive egg mass surveys were also conducted in areas where multiple pheromone-baited moth catches occurred.

In 1989 a total of 68 moths were caught in the mass trapping and detection\delineation survey traps.

In the mass trapping effort, 1,343 traps were placed in Coeur d'Alene covering approximately 150 acres, and 5,907 traps were placed in Sandpoint covering approximately 655 acres. A total of 28 male moths were caught in Coeur d'Alene. Two small infestation areas were delineated. In Sandpoint 23 male moths were caught, again in two pockets.

Based on the positive pheromone trap catches, two locations in

Coeur d' Alene and two in Sandpoint were surveyed for egg masses. In Coeur d' Alene two egg masses were found on a single property. In Sandpoint five egg masses were found. Four of these were found in one area; three on a single tree, and the fourth on an adjacent property.

In **detection\delineation surveys** conducted throughout the state in 1989, 17 other moths were caught, six in Idaho Falls, 1 in Pocatello, four in Coeur d'Alene and six in Sandpoint.

Table I    SURVEYS

PHEROMONE TRAPPING(Number caught)

Detection/ Delineation trapping

	1974-85	1986	1987	1988	1989	1990
Coeur d'Alene			11	87	4	
Sandpoint		1	22	334	6	
Other			2		7	6
TOTALS	0	1	35	421	17	6

Mass Trapping

Coeur d'Alene					28	0
Sandpoint					23	0
TOTALS	NA	NA	NA	NA	51	0

TOTAL MOTHS CAUGHT: 0            1            35            421\*            68            6

EGG MASS SURVEY(Numbers found)

	1986	1987	1988	1989	1990
Coeur d'Alene		3	2	2	
Sandpoint		44	32	5	
TOTAL	NA	47	34	7	**

\* Grid trapping initiated  
\* \* Survey yet to be conducted

Table II TREATMENT ACREAGES

	1988	1989	1990
SPRAY	ground spray Orthene/Dipel	aerial spray Dipel 8L 3 times	aerial spray Foray 48B 3 times
Coeur d'Alene	23 trees 4 properties	110 acres	25 acres
Sandpoint	68 trees 19 properties	270 acres	1035 acres
<u>TOTALS</u>	91 trees 25 properties	380 acres	1060 acres
MASS TRAPPING		9 traps per acre	9 or 5 traps per acre
Coeur d'Alene		150 acres 1343 traps	25 acres 225 traps
Sandpoint		655 acres 5907 traps	1060 acres 3043 traps
<u>TOTALS</u>		805 acres 7250 traps	1060 acres 3268 traps
	NA	805 acres	1060 acres



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R. LADD LIVINGSTON

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The 1989 treatments included three aerial applications of Dipel 8L, a biological insecticide with Bacillus thuringiensis (Bt), and implementation of a mass trapping program as a follow-up to the insecticide treatment. Intensive egg mass surveys were also conducted in areas where multiple pheromone-baited moth catches occurred.

In 1989 a total of 68 moths were caught in the mass trapping and detection\delineation survey traps.

In the mass trapping effort, 1,343 traps were placed in Coeur d'Alene covering approximately 150 acres, and 5,907 traps were placed in Sandpoint covering approximately 655 acres. A total of 28 male moths were caught in Coeur d'Alene. Two small infestation areas were delineated. In Sandpoint 23 male moths were caught, again in two pockets.

Based on the positive pheromone trap catches, two locations in Coeur d'Alene and two in Sandpoint were surveyed for egg masses. In Coeur d'Alene two egg masses were found on a single property. In Sandpoint five egg masses were found. Four of these were found in one area; three on a single tree, and the fourth on an adjacent property.

In detection\delineation surveys conducted throughout the state in 1989, 17 other moths were caught, six in Idaho Falls, 1 in Pocatello, four in Coeur d'Alene and six in Sandpoint.

## Gypsy Moth Survey and Detection Programs - 1990

### Oregon Department of Agriculture

#### Status at the end of the 1989 Survey Season:

In 1989, approximately 22,250 gypsy moth traps were placed statewide. Only two gypsy moths were detected, about three miles apart in Eugene, Lane Co. This was the fewest caught in the state since 1979, the year gypsy moths were first detected in Oregon. No gypsy moths were caught in Lake Oswego, Clackamas Co., the only site receiving eradication sprays (B.t.) in 1989. For the first time since 1980, no eradication programs were planned for the following spring in 1990.

#### 1990 Survey Program:

Nineteen gypsy moths were detected in Oregon in 1990 (Table 1). All detections were in western Oregon; only two traps had multiple catches. Detections were made in nine general areas from north to south as follows: Warrenton (two moths in one trap); Hillsboro (one moth in one trap); West Portland (two single moths in two traps); Lake Oswego (four moths in one trap, plus four scattered singles); Estacada (one moth in one trap); Eugene (two single moths in two traps); Rogue River (two single moths in two traps); and Cave Junction (one moth in one trap).

The two gypsy moths in Eugene were caught about a mile southwest of each of the two single detections made there in 1989. This is down from over 19,000 moths detected in Lane Co. in 1984 and reflects the success of the earlier eradication projects in combination with the detection and delimitation trapping programs. About 6,000 traps were placed in Lane Co. this year. The multiple detection in Lake Oswego (four moths) is about 1/3 mile northeast of the 1989 eradication area. This is likely to be a new introduction site as several move-ins from the northeast have already been identified in the immediate area.

As in previous years, gypsy moth survey and detection traps were concentrated in western Oregon, where most of the suitable habitat and population centers occur. The standard detection trap density was 1-4 traps/mi<sup>2</sup>. Delimitation trap densities of 16-49 traps /mi<sup>2</sup> were placed at all 1989 detection sites, and were used to monitor previous eradication areas. No mass trapping was done in 1990. Special sites such as state and national parks, public and private campgrounds, and RV parks were also trapped.

Approximately 16,335 traps were placed statewide as follows: 11,680 detection traps, 3,755 delimitation traps, and 900 additional delimitation traps added in response to new gypsy moth detections.

#### Projected Eradication and Survey Programs in 1991:

Information gathering regarding recent move-ins from the northeastern U.S. and subsequent egg mass searching are planned at up to five sites where new detections were made: Warrenton, Lake Oswego, Estacada, Rogue River, and Cave Junction. Any eradication programs for 1991 will be based on the results of egg mass searching and detection data in those areas. Eradication programs would likely be less than 640 acres, and use *Bacillus thuringiensis* applied from the ground if possible. Since most of Lane County has been free of gypsy moths for four years, a reduced trapping program is projected for 1991. Delimitation trapping around all 1990 gypsy moth detections, and any eradication sites will supplement our usual survey program.

**Table 1. Summary of 1990 Gypsy Moth Detections in Oregon.**

County	City/Area	Total Males Caught	Trap Density
Clackamas	Estacada	1	1/mi <sup>2</sup> (increased)
	Lake Oswego	8	16/mi <sup>2</sup> (increased)
Clatsop	Warrenton	2	2/mi <sup>2</sup> (increased)
Jackson	Rogue River	2	1/mi <sup>2</sup> (increased)
Josephine	Cave Junction	1	1/mi <sup>2</sup> (increased)
Lane	Eugene	2	16-49/mi <sup>2</sup> (increased)
Washington	Hillsboro	1	4/mi <sup>2</sup>
	Raleigh Hills, W. Portland	1	4/mi <sup>2</sup> (increased)
	Sylvan Hills, W. Portland	1	4/mi <sup>2</sup> (increased)
<b>Statewide total = 19</b>			

Submitted by:

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COLORADO STATE FOREST SERVICE REPORT TO:  
WESTERN REGIONAL GYPSY MOTH MEETING  
SALT LAKE CITY, UTAH  
NOVEMBER 7-8, 1990

Colorado detected its first gypsy moth in 1984. Through 1989, gypsy moths had been detected in 12 separate locations, mostly along the Front Range urbanized corridor. Positive traps in 1989 indicated that going into the 1990 season Colorado potentially had four active gypsy moth populations.

The potential 1990 infestations in Limon, Colorado Springs (Upper Skyway neighborhood) and Rosita were delimitation trapped (25 traps per square mile). To date these areas have produced 0 moths in 1990. All traps have been retrieved, with the exception of 25 in Colorado Springs.

The "East" Fort Collins population (7 acres) was treated May 17 and May 30 with ground-applied Bt (Dipel, at the equivalent of 20 BIU's per acre). A total of 28 properties were involved. This general area was also mass trapped (9 traps per acre) and surrounded by a "halo" of delimitation traps. This area produced 0 moths in 1990.

The "West" Fort Collins infestation area (first year of 0 moths was 1989) was delimitation trapped and produced a second consecutive year of 0 moths. This area is now considered eradicated.

In addition, 2358 detection traps were placed statewide. All 63 Colorado counties received coverage. As of this date, all but 41 traps have been retrieved. No gypsy moths have been found in detection traps in 1990.

In summary, for the first year since 1984, Colorado has produced no gypsy moths in traps. All traps have been retrieved with the exception of traps located in the Nucla, Ouray, Gunnison and Alamosa areas.

The following infestation or positive-catch areas are now considered eradicated: Rocky Mountain National Park, Boulder (three areas), "West" Fort Collins, Colorado Springs (Broadmoor), LaPorte (KOA), and Lakewood.

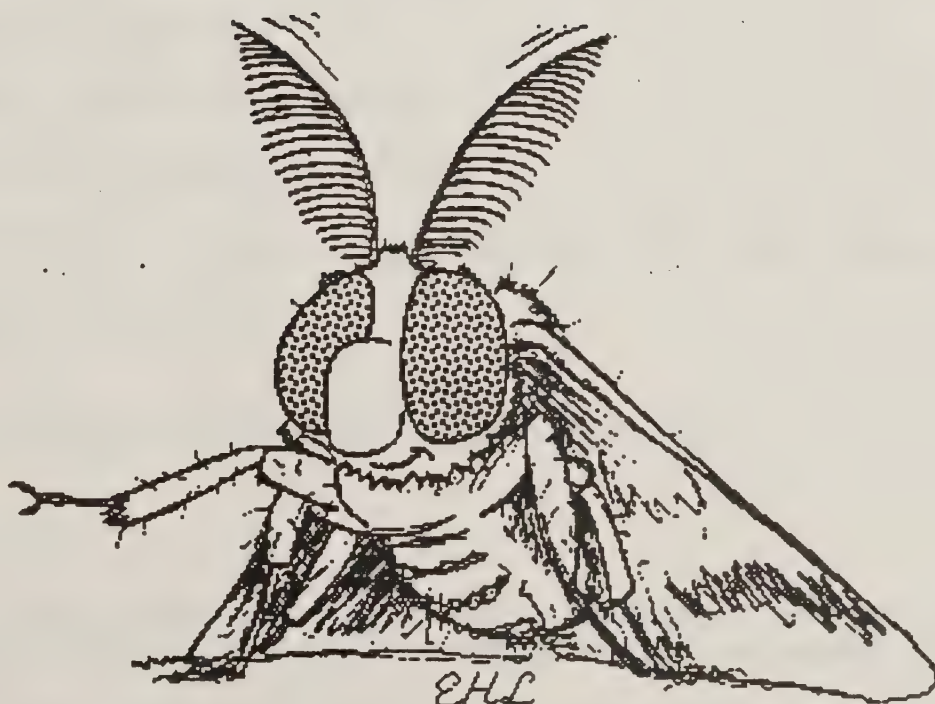
The following areas are considered conditionally eradicated (i.e., one year of 0 catches): Limon, Colorado Springs (Upper Skyway), Rosita, "East" Fort Collins.

PLANS FOR 1991: Efforts will concentrate on detection trapping, with delimitation trapping planned for the above four conditionally eradicated areas.



Washington State Department of Agriculture  
Plant Services Division

## 1990 GYPSY MOTH PROGRAM SUMMARY REPORT





WSDA - PLANT SERVICES DIVISION  
1990 G.M. PROGRAM SUMMARY REPORT

SURVEY & DETECTION:

6889 detection and 1739 delimiting traps were placed for gypsy moth in Washington State in 1990, for a total of 8628 traps.

72 gypsy moths were reported from 46 traps.

Nineteen total catch areas were reported in 1990, up from 13 in 1989. This increase in catch areas, reflecting increased gypsy moth introductions, is the highest since 1983 (see Table I).

Table 1. GM Catch History

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
# CATCH AREAS	10	14	16	24	13	14	15	17	12	13	19
# TRAPS	~750	~6000	~6000	6224	6299	9208	7329	7484	7706	8471	8628
#MOTHS	212	268	827	1314	161	175	56	39	128	202	72

Thirteen new catch areas were recorded in 1990:

- Clark Co. (Hockinson & Orchards)
- Cowlitz Co. (Longview)
- King Co. (Kent & West Seattle)
- Kitsap Co. (Poulsbo & Port Orchard)
- Snohomish Co. (Marysville, Everett, Brier, Mill Creek & Monroe)
- Stevens Co. (Colville)

Seven 1989 catch areas did not repeat in 1990 (see Table 2).

ERADICATION:

Fifteen moths were caught in the Manor area in 1990 after a two-part aerial application of Bt (Foray 48B at 24 BIU & 1/2 gallon/acre) was applied to 400 acres.

Egg mass searches and possible follow-up spraying will occur at Arlington and Bellingham.

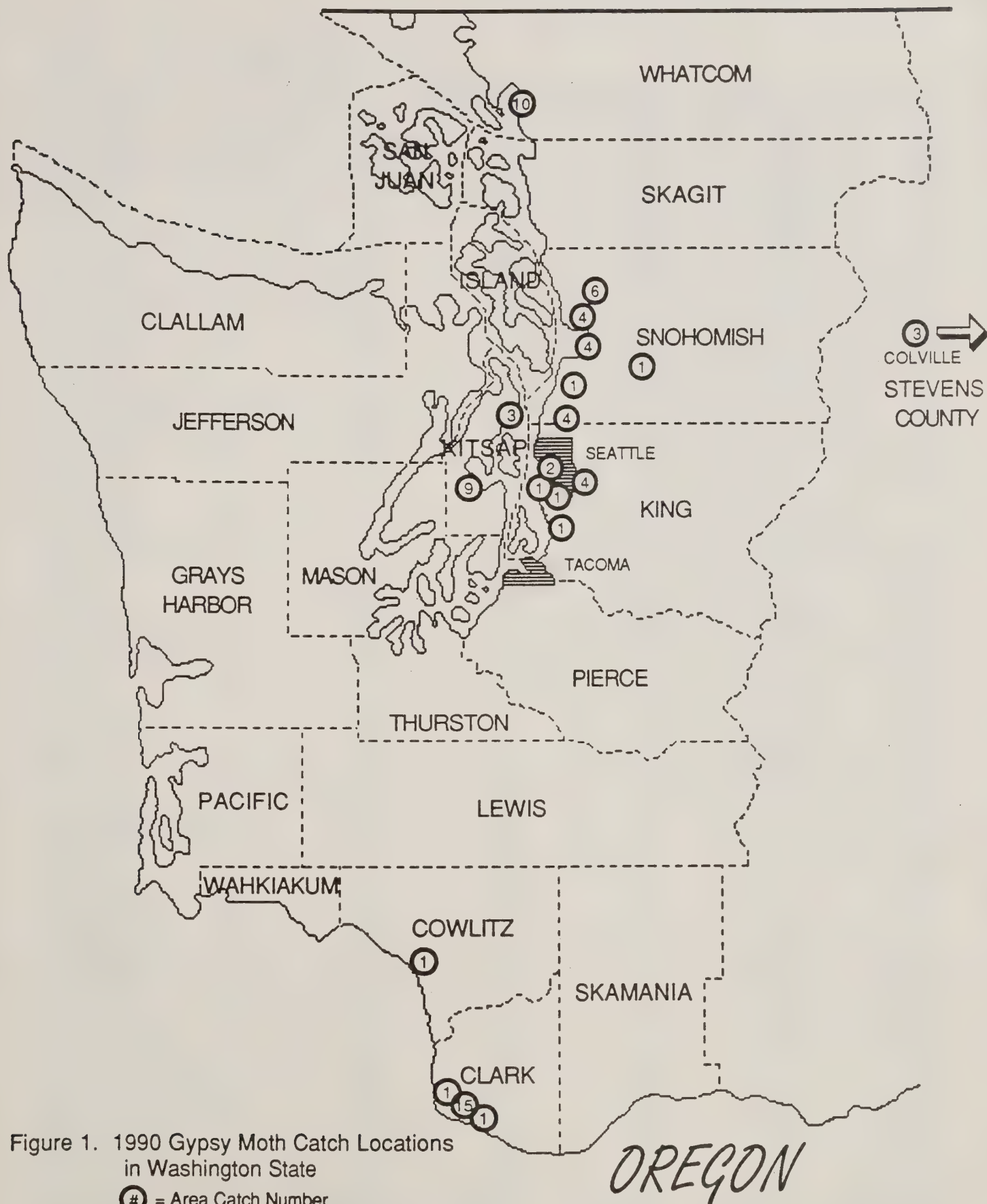
WSDA - PLANT SERVICES DIVISION  
1990 G.M. PROGRAM SUMMARY REPORT

Table 2. 1989 - 1990 W.S.D.A Gypsy Moth Survey Results

County	Catch Area	1989		1990		Control Actions
		Total Catch	No. Trap Sites	Total Catch	No. Trap Sites	
CLALLAM	Sequim	5	3	0	0	
CLARK	☼ Hockinson	0	0	1	1	(4-'89) (1-'90)
"	Manor	169	90	15	12	
"	☼ Orchards	0	0	1	1	
COWLITZ	☼ Longview	0	0	1	1	
KING	Bellevue	1	1	0	0	
"	Bryne Mawr	1	1	1	1	
"	Issaquah	4	4	4	2	
"	☼ Kent	0	0	1	1	
"	Mercer Island	2	2	0	0	
"	Ravenna	2	2	2	2	
"	☼ West Seattle	0	0	1	1	
KITSAP	Bainbridge Isl.	6	4	0	0	(2,3-'89)
"	Olalla	3	3	0	0	
"	☼ Poulsbo	0	0	3	2	
"	☼ Port Orchard	0	0	9	6	
PIERCE	N. Puyallup	6	5	0	0	
SNOHOMISH	Arlington	1	1	6	1	
"	☼ Marysville	0	0	4	4	
"	☼ Everett	0	0	4	3	
"	☼ Brier	0	0	4	2	
"	☼ Monroe	0	0	1	1	
"	☼ Mill Creek	0	0	1	1	
STEVENS	☼ Colville	0	0	3	1	
THURSTON	Offut Lake	1	1	0	0	
WHATCOM	Bellingham	1	1	10	4	
Totals		202	118	72	46	

- (1) Aerial Bt
- (2) Egg Mass Search (Positive)
- (3) Ground Sprays (Orthene)
- (4) Mass Trapping (Mating Disruption)
- ☼ New Site

CANADA





WSDA - PLANT SERVICES DIVISION  
1990 G.M. PROGRAM SUMMARY REPORT

Table 3. 1990 G.M. Trap Deployment

COUNTY	9/acre	36/mile	4/mile	1/mile	TOTAL
ADAMS	0	0	0	0	0
ASOTIN	0	0	0	2	2
BENTON	0	0	0	37	37
CHELAN	0	0	0	21	21
CLALLAM	0	56	43	220	319
CLARK	331	175	83	453	1042
COLUMBIA	0	0	0	1	1
COWLITZ	24	0	0	359	383
DOUGLAS	0	0	0	0	0
FERRY	0	0	0	0	0
FRANKLIN	0	0	0	8	8
GARFIELD	0	0	0	1	1
GRANT	0	0	0	0	0
GRAYS HARBOR	0	0	0	401	401
ISLAND	0	0	0	36	36
JEFFERSON	0	0	0	162	162
KING	32	311	107	649	1099
KITSAP	20	143	69	442	674
KITTITAS	0	0	0	27	27
KLICKITAT	0	0	0	53	53
LEWIS	0	0	0	483	483
LINCOLN	0	0	0	0	0
MASON	0	0	0	398	398
OKANOGAN	0	0	0	95	95
PACIFIC	0	0	0	262	262
PEND ORIELLE	0	0	0	8	8
PIERCE	31	39	31 <del>434</del>	555	656 <del>585</del>
SAN JUAN	0	0	0	91	91
SKAGIT	0	0	0	468	468
SKAMANIA	0	0	0	20	20
SNOHOMISH	0	78	55	370	503
SPOKANE	0	0	0	202	202
STEVENS	0	0	0	70	70
THURSTON	0	25	10	347	382
WAHKIAKUM	0	0	0	109	109
WALLA WALLA	0	0	0	11	11
WHATCOM	0	36	40	540	616
WHITMAN	0	0	0	0	0
YAKIMA	0	0	0	149	149
TOTALS	438	863	438	6889	8628

WSDA - PLANT SERVICES DIVISION  
1990 G.M. PROGRAM SUMMARY REPORT

Table 4. 1990 Federal Land Gypsy Moth Trap Deployment

FACILITY	TRAPS
Bangor Submarine Base	28
Chehalis Indian Reservation	4
Colville National Forest	5
Fort Lewis	19
Gifford Pinchot National Forest	46
Lummi Indian Reservation	17
McCaw Indian Reservation	2
McChord Air Force Base	11
Mount Rainier National Park	12
Mount Baker-Snoqualmie National Forest	107
North Cascades National Park	48
Okanogan National Forest	37
Olympic National Forest	75
Olympic National Park	35
Port Gamble Indian Reservation	3
Port Madison Indian Reservation	5
Quinault Indian Reservation	3
Skokomish Indian Reservation	3
Swinomish Indian Reservation	13
Tulalip Indian Reservation	19
Wenatchee National Forest	62
Yakima Indian Reservation	9
Total	563

(Federal Trap Numbers are included in Table 3 Totals)





Pennsylvania Gypsy Moth Suppression Project

1990

Larry D. Rhoads, Supervisor  
Suppression Activities Section  
Division of Forest Pest Management  
Bureau of Forestry  
Office of Resources Management  
Department of Environmental Resources  
34 Airport Drive  
Middletown, Pennsylvania 17057-5080  
August 1990



## Pennsylvania Gypsy Moth Suppression Project - 1990

### Summary

Of the 900,000+ acres of forestland that were originally proposed on October 1, 1989, for treatment in Pennsylvania's 1990 state/federal/county cooperative gypsy moth suppression project, more than 772,000 acres (480,000 private residential, 262,000 State Forest, 28,000 State Park, 1,900 federal, and 449 other) qualified under the Pennsylvania DER program standards. Unfortunately, based upon estimated aerial application costs, available state funds were adequate to treat only about 30 percent of that total. Therefore, in order to keep a roughly equal division between privately and publicly owned acreage, a 75 percent reduction was made in the approved private residential acreage and a 60 percent reduction in the State Forest and State Park acreage. Bids were then solicited on this reduced acreage.

In an effort to contain the ever-increasing costs associated with helicopter-only contracts, five of the six 1990 contracts were opened to either helicopters or fixed-wing aircraft. As a result, the average overall bid price came in at approximately one-half of the projected cost, and we suddenly had a surplus \$1.9 million to make available for gypsy moth suppression. Because of the inflexibility of the Commonwealth bidding-and-contract-execution procedures, it was not possible at that time (late January 1990) to rebid and increase the acreage. Therefore, it was decided to make these surplus monies available to cooperating municipalities under the Option II portion of the program's operating procedure. Under this option, the cooperator is responsible for obtaining a contract with an aerial applicator and supervising the spray operation. DER would then cost-share the project at the rate of \$12 per acre to cover a portion of the insecticide, application, and overhead costs. A total of 53 municipalities participated under Option II to treat more than 155,800 additional acres for the citizens of Pennsylvania.

Spraying operations for the Option I portion of the 1990 project began on May 6 in District 3 (Cumberland, Franklin, and Perry Counties) and ended on June 2 in District 4 (Somerset County). Overall, a total of 237,319 acres involving 1,400 blocks were treated by the Bureau of Forestry under this option. Of that total, 121,001 acres (1,127 blocks) were treated with Bacillus thuringiensis (Bt) and 116,318 acres (273 blocks) with diflubenzuron (DFB). All of the bureau's 20 forest districts were involved in the operation which took place in portions of 53 of the Commonwealth's 67 counties.

Under the Option II program, DER cost-shared on 154,155 acres treated with Bt and 1,697 acres treated with DFB. All of the Bt acreage except for four acres in Allegheny County, 505 acres in Carbon County, and 176 acres in Monroe County were private residential. The four Bt acres and all of the DFB acreage in Allegheny County involved county parks, while the nonprivate residential Bt acreage in Carbon and Monroe Counties was watershed managed by the Bethlehem Water Authority.

The 1990 spring season was characterized by very warm temperatures in mid-April which brought about a general statewide hatch of gypsy moths during late April. As a result, spraying operations in all parts of the state started at approximately the same time increasing the pressure on the contractors' and the bureau's personnel and equipment. Population density was so heavy in parts of the Commonwealth, especially the eastern, that the larvae were devouring the foliage as quickly as it emerged. In this program our objective is to keep defoliation below 30 percent. However, in many of these areas, the population density was so high that the 30 percent level was exceeded by first-instar larvae before we had a chance to spray. The final straw that may have broken our backs in many areas was the extensive blowing of caterpillars that occurred this year. Cool weather set in after the warm episode in April resulting in prolonged hatch at the higher elevations. The number of larvae and the length of time they were blowing around were greater and longer than any of the old-timers working on the project can remember. It was felt by field personnel that many areas were sufficiently reinfested by blowing larvae after spraying occurred to compromise the effectiveness of the St and, in some cases, the DFS sprays.

Details on the overall 1990 cooperative gypsy moth suppression project are given in the following sections.

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### Option I Contracts

The 1990 Option I project was divided into six geographical areas as shown on the map below. A separate contract was bid and let for each of these areas with the successful bidders as follows:

<u>Contractor</u>	<u>Contracts</u>
Altair, Inc. Franklin County Airport R. D. 2, Box 279 Swanton, VT 05488 802-868-7951	90-1 90-2 90-4 90-5
Helicopter Applicators, Inc. P. O. Box 810 Frederick, MD 21701 301-663-1330	90-3
K & K Aircraft, Inc. P. O. Box 7 Bridgewater, VA 22812 703-828-6070	90-6

### Contract Areas - Option I

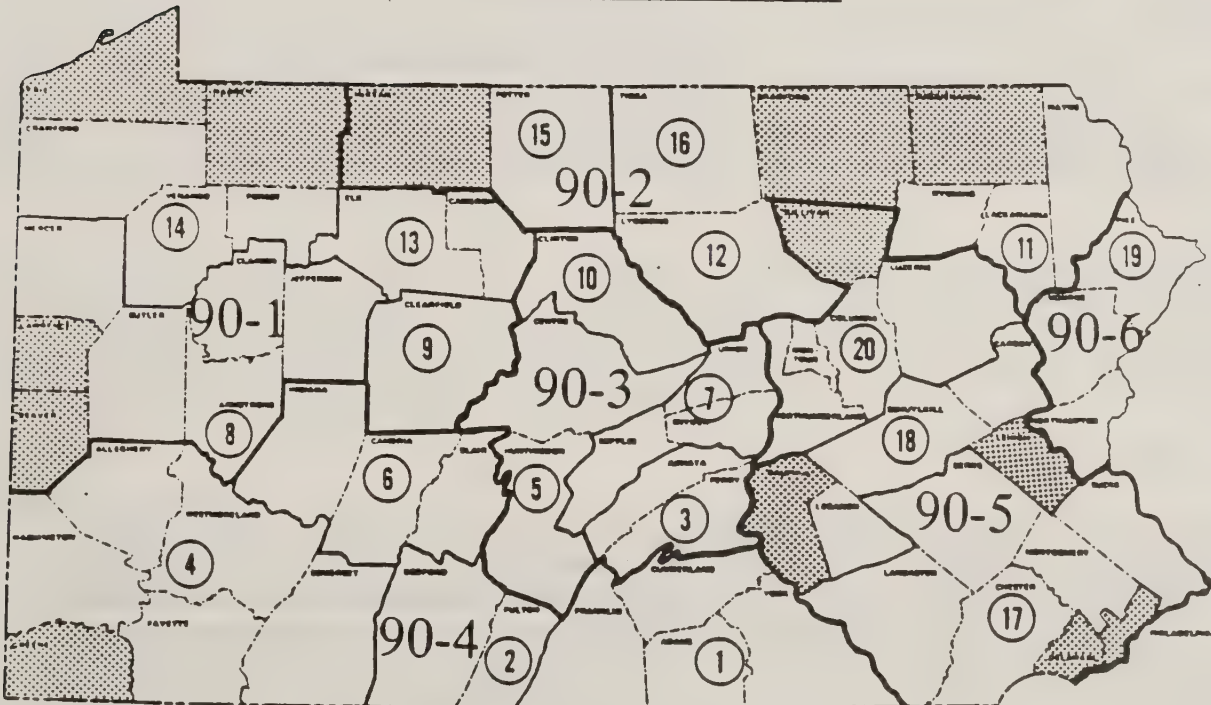


Table 10 provides a breakdown of the cost of insecticide and application for each of the Option I contracts. The "actual cost per acre" is calculated on the actual amount of insecticide applied to treat the designated acreage taking into account any extra material that had to be added because of calibration tolerance, minor acreage calculation discrepancies, or by the necessity to retreat (Bt only) after unexpected heavy rains.

Table 11 is an account of the daily spraying progress for each contract and for the overall project.

### Option II Contracts

Table 12 shows the contractor, the contracted price, the spray material, and the rate of application for each of the Option II cooperators. The total cost to the cooperator for the Option II acreage that was cost-shared by DER was \$1,936,796.06 or an average of \$12.43 per acre. DER cost-shared \$1,870,224 of that total.

The addresses and phone numbers for the Option II contractors follow:

Aero Tech, Inc.  
Box 517, Highway 60  
Bovina, TX 79009  
806-238-1331

Cordoba Helicopter Enterprises, Inc.  
R. D. 1, Applegarth Road  
Hightstown, NJ 08520  
609-448-0031

AgRotors, Inc.  
Box 578  
Gettysburg, PA 17325  
717-334-6777

Evergreen Helicopters, Inc.  
3850 Three Mile Lane  
McMinnville, OR 97128  
503-472-9361

Altair, Inc.  
Franklin County Airport  
R. D. 2, Box 279  
Swanton, VT 05488  
802-524-0164

Helicopter Applicators, Inc.  
P. O. Box 810  
Frederick, MD 21701  
301-663-1330

Appalachian Helicopters, Inc.  
Route 1, Box 36D  
Ridgway, PA 15853  
814-776-1466

K & K Aircraft, Inc.  
P. O. Box 7  
Bridgewater, VA 22812  
703-828-6070

Bob Ruhe Ag Service  
122 Commercial Street  
Leipsic, OH 45856  
419-943-3352

### Insecticides

Two insecticides, Bacillus thuringiensis (Bt) and diflubenzuron (DFB), were used on the 1990 project for both Option I and Option II. Three different Bt formulations were used. Condor OF, an oil-based formulation produced by Ecogen, Inc., was applied diluted (one gallon) at 24 BIU per acre to 7,780 (6,280--Option I, 1,500--Option II) acres. An aqueous-based formulation, Dipel 8AF (Abbott Laboratories, Inc.), was used diluted (one gallon) at 16 BIU on 189,274 (98,184--Option I, 91,090--Option II), diluted (three quarts) at 16 BIU on 2,596 (Option I) acres, diluted (one gallon) at 20 BIU on 13,828 (Option II) acres, and diluted (three quarts) at 21 BIU on 1,048 (Option II) acres for a total of 206,746 acres. Another aqueous formulation, Foray 48B (Novo Laboratories, Inc.), was applied to a total of 60,630 acres. Of this total Foray acreage, 29,955 (2,807--Option I, 27,148--Option II) acres were

treated diluted (one gallon) at 16 BIU per acre, 13,333 (Option II) acres were treated diluted (one gallon) at 20 BIU, 6,622 (Option I) acres were treated undiluted (53 ounces) at 20 BIU per acre, 9,317 (3,109--Option I, 6,208--Option II) acres were treated diluted (one gallon) at 24 BIU per acre, and 1,403 (Option I) acres were treated undiluted (80 ounces) at 30 BIU per acre.

The only commercially available formulation of DFB, Dimilin 25W, was used on this project. Of the total 118,015 acres treated with DFB, 116,118 acres in the Option I project were treated with .40 ounce active ingredient (AI) per acre which equals 1.6 ounces of Dimilin 25W. This rate represented a 20 percent reduction from the .50 AI rate used over the past several years. While most of that acreage (105,439) was treated with a final spray volume of one gallon per acre, 10,679 acres were treated with a final spray volume of three quarts per acre applied with rotary atomizers. In an effort to see if the rate of DFB application can be reduced even lower, two 50-acre blocks were treated with .04 ounce AI per acre and two 50-acre blocks were treated with .004 ounce AI per acre at a final spray volume of one gallon per acre. In the Option II project, 1,697 acres were treated with .50 ounce AI (two ounces Dimilin 25W per gallon water) per acre. Information on insecticides used is presented in Table 13.

#### Aircraft

A total of 21 spray aircraft were used on the 1990 Option I project. Table 14 lists all these aircraft along with information on the pilots and contracts while Table 15 gives calibration information for each of the aircraft. Table 16 provides 1990 production data for each of the spray aircraft, and Table 17 shows the cumulative production data for each model of aircraft. Table 18 provides information on the observation aircraft used by certain districts during the project.

Nine different aerial applicators provided a total of 37 spray aircraft for the 1990 Option II project. Table 19 lists these aircraft along with the pilot's name by contractor. Production data for each aircraft is given in Table 20 and for each model of aircraft in Table 21. Calibration information is not available for the Option II aircraft.

#### Project Incidents

Several incidents, including two pilot fatalities, which required reporting to the USDA Forest Service and other authorities occurred during the course of the 1990 suppression project. Additional information is available regarding these incidents if needed. The following provides brief synopses of them:

May 7, 1990 - Sixty gallons of mixed Bt were applied off site by an aircraft (Cessna 188 Ag Truck, N731ET) in Northampton County during the course of the Lehigh County Option II project. A downed marker balloon is felt to be the cause of the error. No persons are known to have been impacted.

May 8, 1990 - A spray aircraft (Air Tractor AT-400, N2369N) piloted by Ted Stallings, Aero Tech, Inc., Bovina, Texas, contacted an electric transmission line in Blair County and crashed while treating a Blair County Option II block. Mr. Stallings suffered severe burns and broken bones but survived the crash. The National Transportation Safety Board (NTSB) is investigating the accident and will issue a report.

May 12, 1990 - A portion of State Forest land in District 16, not slated for treatment but contiguous with a scheduled block, was sprayed with DFB when two tandem-flying aircraft (Turbine Thrushes, N7155S and N7155W) missed a cutoff point. The area sprayed was part of a larger area deleted from the original treatment proposal because it contained a wetland community supporting populations of Lycaena epixanthe, a species of concern as contained in the Pennsylvania Natural Diversity Inventory.

May 15, 1990 - An observation aircraft (Cessna 182D, N8757X) crashed en route from the Northumberland County Airport to the Hazleton Municipal Airport to pick up a Bureau of Forestry employee. The pilot, Frank Pavelko, was killed.

May 23, 1990 - A spray aircraft (Grumman Ag-Cat, N913X) working on the Luzerne County Option II project contacted a powerline over the Susquehanna River and crashed. The pilot, Mike Hensel with Downtown Aero Crop Service, Vineland, New Jersey, under subcontract to K & K Aircraft, Inc., Bridgewater, Virginia, was killed.

May 24, 1990 - A spray aircraft (Cessna A-188B Ag Truck, N2200F) showed zero oil pressure while treating a spray block in Luzerne County on the Option I project. Approximately 75 gallons of mixed Bt insecticide were dumped in an isolated, wooded area, and the pilot was able to return to base safely.

May 24, 1990 - Approximately two to four gallons of mixed DFB insecticide were spilled on the airport tarmac at Connellsville Airport, Fayette County, when the aircraft (Bull Thrush, N2239S) began to taxi before the filler hose was removed. Any insecticide that wasn't blown away by the prop blast was hosed off with clean water by the ground crew.

May 25, 1990 - Approximately 25 acres in Bedford County were sprayed off site with mixed Bt insecticide by an aircraft (Grumman Ag-Cat, N7155J) treating acreage on the Option I project. The pilot became confused by marker balloons placed by a private contractor spraying in the same area. The landowners were very happy with the extra treatment.

### Program Changes

#### Landowner Notification

Current procedures require the county cooperators to notify all landowners within approved treatment areas of the impending spraying. This notification must be in writing and must be made by first-class mail or personal service. In an effort to evaluate a less labor-intensive method of meeting this notification requirement, Carbon County was permitted to run legal advertisements (one-half page) in three local newspapers. As a result, the county received hundreds of phone calls requesting additional information and five objections

to spraying. The number of objections is comparable to what is received from first-class mail notification. It is the opinion of the county that this method is less expensive, more effective, and more informative than the letters sent only to landowners within the spray blocks. The procedure will be investigated further for use in future projects.

#### Posting of State-Owned Land Spray Blocks

In order to advise persons using State Forest and State Park lands of the possibility of spraying while they are on those lands, a warning placard was developed. Forestry and Parks personnel were instructed to place these at trailheads, access roads, picnic areas, and other places within a treatment area where they would be readily noticeable by the public.

#### Project Evaluation

A separate project was conducted to determine how effective we were in meeting our objectives of keeping defoliation below 30 percent on residential and public lands, and, on lands where DFB was used, of precluding the need for treatment the following year. Postspray defoliation estimates were made at peak defoliation time in virtually all of the Option I blocks and approximately 50 percent of the Option II blocks. A postseason egg mass count will be made in DFB-treated blocks.

The extensive delayed hatch and subsequent blowing of neonate larvae which occurred during the spring of 1990, severely compromised the integrity of many of the treated blocks. With many of the blocks, blow-in occurred a week or two after spraying and at such intensity that the blow-in population equalled or exceeded the initial pretreatment larval population. As a result, treatment success with Bt was evident in only about 60 percent of the blocks and with DFB, in about 70 percent. A more detailed report on this evaluation will be prepared and be available upon request.

#### Additional Documentation

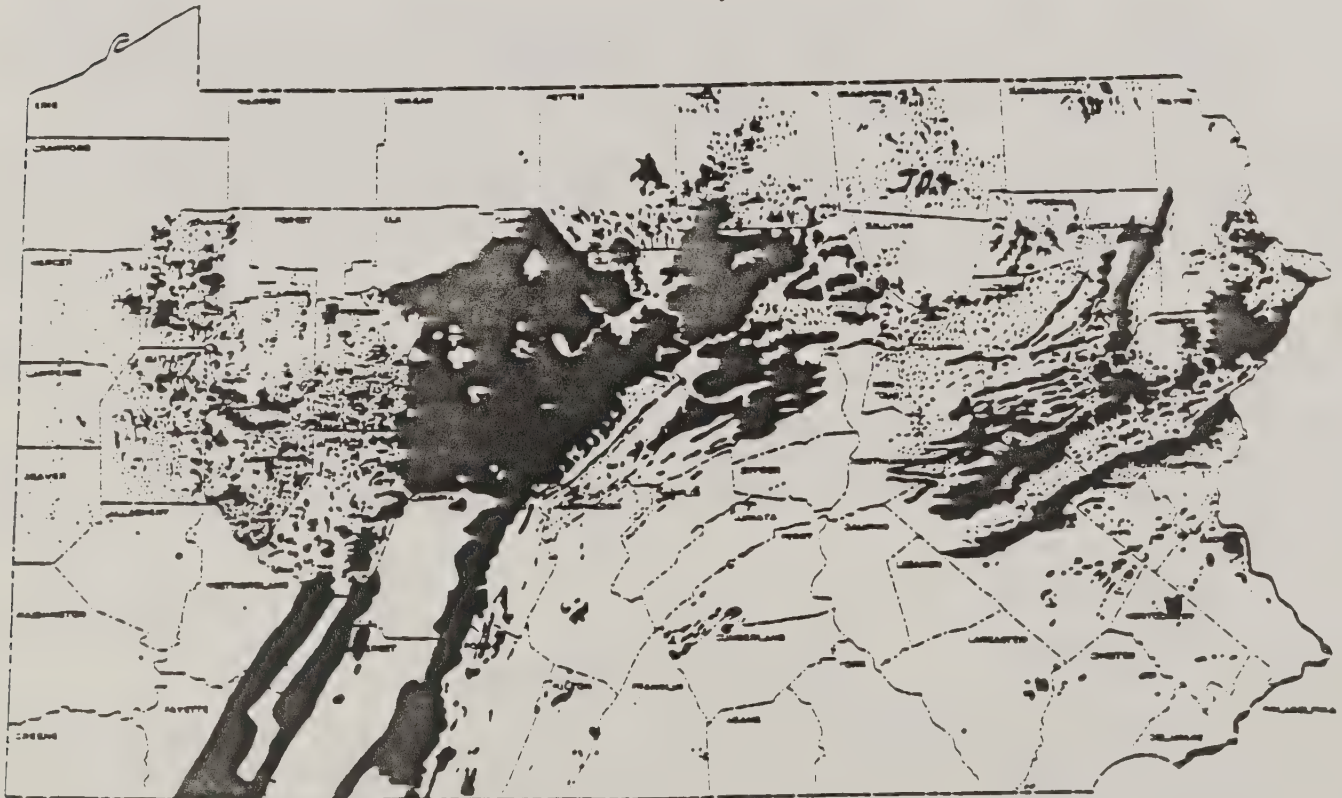
The following documents are an integral part of the 1990 gypsy moth suppression project and are available upon request from the Division of Forest Pest Management in Middletown or, where indicated, from the appropriate district office:

- o Contract Specifications
- o Contractor's Agreement
- o County's (Cooperator's) Agreement
- o Environmental Assessment
- o Work and Safety Plan
- o Procedure for Cooperator Participation Manual

- Operating Procedure and Deadlines Manual
- Natural Area Project Reviews
  - Bucktail (Cameron County)
  - Hemlocks (Perry County)
  - Johnson Run (Cameron County)
  - Masland (Perry County)
  - Mount Davis (Somerset County)
  - Pine Ridge (Bedford County)
  - Roaring Run (Westmoreland County)
- Spray Block Maps (for review only at district office)
- Proposal Forms (for review only at district office)
- District Project Summaries (for review only at district office)

#### Defoliation by Gypsy Moth - 1990

The following map and Table 22 provide information on the location and intensity of gypsy moth defoliation which occurred in the Commonwealth during 1990. Moderate defoliation is 31-60 percent while heavy is greater than 61 percent.



# Forest District and FPM Areas of Responsibility

During 1990 all 20 forest districts and five FPM areas were involved with a portion of the gypsy moth suppression project. The areas of responsibility in effect in 1990 are shown on the map. DF = district forester, DPL = district gypsy moth program leader, AFPMS = area Forest Pest Management specialist, AAFPMS = assistant area Forest Pest Management specialist.

Kenneth D. Swartz (DF)  
Philip Wert (DPL)  
Michaux Forest District (1)  
10099 Lincoln Way East  
Fayetteville, PA 17222  
717-352-2211

Warren Ely (DF)  
Ernest H. Geanette (DPL)  
Tuscarora Forest District (3)  
R. D. 1, Box 42A  
Blain, PA 17006  
717-536-3191

Ralph E. Heilig (DF)  
Paul H. McDonel (DPL)  
Rothrock Forest District (5)  
Box 403, 418 Penn Street  
Huntingdon, PA 16652  
814-643-2340

Robert F. Laubach (DF)  
Robert A. Kurilla (DPL)  
Bald Eagle Forest District (7)  
Box 147  
Laurelton, PA 17835  
717-922-3344

Paul Augustine (DF)  
Edward A. Richards (DPL)  
Moshannon Forest District (9)  
Box 952  
Clearfield, PA 16830  
814-765-3741

Anthony D. Santoli (DF)  
Gerald Kelly (DPL)  
Lackawanna Forest District (11)  
Room 401, State Office Building  
100 Lackawanna Avenue  
Scranton, PA 18503  
717-963-4561

George R. Winning (DF)  
James E. Pflieger (DPL)  
Buchanan Forest District (2)  
R. D. 2, Box 3  
McConnellsburg, PA 17233  
717-485-3148

David B. Williams (DF)  
John T. Wallace (DPL)  
Forbes Forest District (4)  
P. O. Box 519  
Laughlintown, PA 15655  
412-238-9533

E. Gary Scott (DF)  
Thomas E. Grenfell (DPL)  
Gallitzin Forest District (6)  
131 Hillcrest Drive  
Ebensburg, PA 15931  
814-472-8320

David L. Steward (DF)  
Walter J. Visneski (DPL)  
Kittanning Forest District (8)  
South Second Avenue  
Clarion, PA 16214  
814-226-1901

Robert F. Davey, Jr. (DF)  
Richard Kugel (DPL)  
Sproul Forest District (10)  
HCR 62, Box 90  
Renovo, PA 17764  
717-923-1450

Charles W. Kiehl (DF)  
William C. Miller (DPL)  
Tiadaghton Forest District (12)  
423 East Central Avenue  
South Williamsport, PA 17701  
717-327-3450

Robert Martin (DF)  
 Richard Lancaster (DPL)  
 Elk Forest District (13)  
 R. D. 1, Route 155, Box 327  
 Emporium, PA 15834  
 814-486-3353

David O. Schiller (DF)  
 Cornelius Brown (DPL)  
 Susquehannock Forest District (15)  
 P. O. Box 673  
 Coudersport, PA 16915  
 814-274-8474

Maurice Hobaugh (DF)  
 Jeffrey Stuffle (DPL)  
 Valley Forest Forest District (17)  
 R. D. 2, Route 23  
 Pottstown, PA 19464  
 215-469-6217

Kenneth F. Rhody, Jr. (DF)  
 Arthur T. Hoehne (DPL)  
 Delaware Forest District (19)  
 474 Clearview Lane  
 Box 150  
 Stroudsburg, PA 18360  
 717-424-3001

Donald Wary (DF)  
 James F. Hall/Charles C. Thompson (DPL)  
 Cornplanter Forest District (14)  
 323 North State Street  
 North Warren, PA 16365  
 814-723-6951

John K. Sherwood, Jr. (DF)  
 Michael Machmer (DPL)  
 Tioga Forest District (16)  
 Box 94, Route 287S  
 Wellsboro, PA 16901  
 717-724-2868

Donald P. Oaks (DF)  
 Frank Snyder (DPL)  
 Weiser Forest District (18)  
 Box 99  
 Cressona, PA 17929  
 717-385-2545

Robert M. Coy (DF)  
 Albert Schutz (DPL)  
 Wyoming Forest District (20)  
 P. O. Box 439  
 Bloomsburg, PA 17815  
 717-387-4255

\* \* \*

Gary E. Laudermilch (AFPMS)  
 Northern Area  
 Box 94, Route 287S  
 Wellsboro, PA 16901  
 717-724-2868

Thomas C. Bast (AFPMS)  
 Joseph Gaughan (AAFPMS)  
 Eastern Area  
 P. O. Box 439  
 Bloomsburg, PA 17815  
 717-387-4255

Alan C. Sior (AFPMS)  
 James D. Unger (AAFPMS)  
 Central Area  
 R. D. 1, Box 42A  
 Blain, PA 17006  
 717-536-3191

Norman C. Kauffman (AFPMS)  
 Western Area  
 Box 952  
 Clearfield, PA 16830  
 814-765-3741

E. Michael Blumenthal (AFPMS)  
 Charles R. Hoover (AAFPMS)  
 Southern Area  
 HCR 64, Box 130  
 Harrisonville, PA 17228  
 814-735-3544

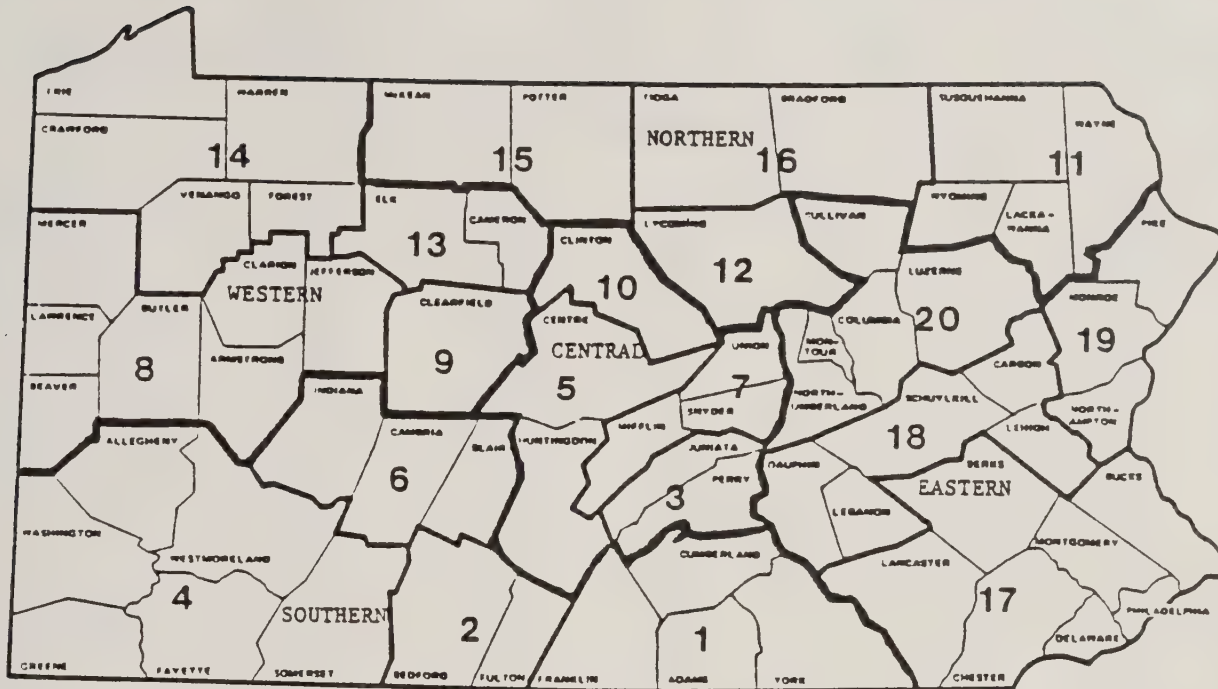




Table 1. Private residential acreage treated - 1990 - Option I.

County	Forest District	Bt		DFB		County Total	
		Acres	Blocks	Acres	Blocks	Acres	Blocks
Allegheny-IPM	4	2,147	10	1,538	7	3,685	17
Armstrong	8	992	23	-	-	992	23
Bedford	2	1,237	37	-	-	1,237	37
Berks	17	2,119	60	-	-	2,119	60
Blair	6	2,066	6	-	-	2,066	6
Bucks	17	1,592	7	-	-	1,592	7
Butler	8	270	10	-	-	270	10
Cambria	6	1,110	11	-	-	1,110	11
Cameron	13	310	4	-	-	310	4
Carbon	18	8,467	38	-	-	8,467	38
Centre	7	1,787	17	-	-	1,787	17
Chester	17	1,021	2	-	-	1,021	2
Clarion	8	2,670	32	-	-	2,670	32
Clearfield	9	2,169	108	-	-	2,169	108
Clinton	10	542	16	-	-	542	16
Columbia	20	2,039	18	-	-	2,039	18
Crawford	14	435	9	-	-	435	9
Cumberland	1	440	7	-	-	440	7
Elk	13	319	15	-	-	319	15
Forest	14	606	11	-	-	606	11
Franklin	1	688	6	-	-	688	6
Fulton	2	399	1	-	-	399	1
Indiana	6	1,758	44	-	-	1,758	44
Jefferson	8	1,430	34	-	-	1,430	34
Juniata	3	102	1	-	-	102	1
Lackawanna	11	2,084	13	-	-	2,084	13
Lancaster	17	2,260	17	-	-	2,260	17
Lebanon	18	164	3	-	-	164	3
Luzerne	20	6,581	37	-	-	6,581	37
Lycoming	12	1,102	20	-	-	1,102	20
Mercer	8	154	6	-	-	154	6
Monroe	19	25,963	41	-	-	25,963	41
Montgomery	17	1,184	7	-	-	1,184	7
Montour	20	456	19	-	-	456	19
Northampton	19	2,600	36	-	-	2,600	36
Northumberland	20	724	16	-	-	724	16
Perry	3	23	1	-	-	23	1
Pike	19	13,042	57	-	-	13,042	57
Schuylkill	18	4,959	43	-	-	4,959	43
Snyder	7	114	4	-	-	114	4
Somerset	4	2,644	139	-	-	2,644	139
Union	7	155	4	-	-	155	4
Venango	14	3,711	8	-	-	3,711	8
Washington	4	106	3	-	-	106	3
Wayne	11	3,463	10	-	-	3,463	10
Wyoming	11	359	8	-	-	359	8
York	1	605	2	-	-	605	2
Totals		109,168	1,021	1,538	7	110,706	1,028

Table 2. State Forest acreage treated - 1990 - Option I.

Forest District	County	Bt		DFB		District Total	
		Acres	Blocks	Acres	Blocks	Acres	Blocks
1 (Michaux)	Adams	-	-	476	1	1,400	5
	Cumberland	58	1	283	1		
	Franklin	-	-	583	2		
2 (Buchanan)	Bedford	-	-	1,927	6	2,745	8
	Franklin	-	-	225	1		
	Fulton	-	-	593	1		
3 (Tuscarora)	Cumberland	-	-	437	4	8,850	24
	Franklin	-	-	579	3		
	Perry	-	-	7,834	17		
4 (Forbes)	Fayette	-	-	7,144	13	20,811	23
	Somerset	-	-	9,772	6		
	Westmoreland	-	-	3,895	4		
5 (Rothrock)	Huntingdon	-	-	4,125	6	4,125	6
7 (Bald Eagle)	Centre	-	-	3,351	8	7,775	28
	Clinton	-	-	1,724	7		
	Union	-	-	2,700	13		
8 (Kittanning)	Jefferson	-	-	115	5	402	6
	Venango	287	1	-	-		
9 (Moshannon)	Cameron	-	-	461	2	36,081	73
	Centre	-	-	7,336	8		
	Clearfield	-	-	28,164	61		
	Clinton	-	-	20	1		
	Elk	-	-	100	1		
10 (Sprout)	Clinton	-	-	10,825	7	10,825	7
11 (Lackawanna)	Lackawanna	492	2	-	-	492	2
12 (Tiadaghton)	Lycoming	-	-	2,500	9	2,500	9
13 (Elk)	Cameron	-	-	3,799	13	5,867	22
	Elk	-	-	1,433	7		
	Potter	-	-	635	2		
15 (Susquehannock)	Clinton	-	-	434	2	3,304	10
	Potter	-	-	2,870	8		
16 (Tioga)	Tioga	-	-	4,700	4	4,700	4
18 (Weiser)	Berks	-	-	380	2	1,200	9
	Schuylkill	-	-	820	7		
19 (Delaware)	Monroe	139	3	-	-	2,800	17
	Pike	2,661	14	-	-		
20 (Wyoming)	Columbia	-	-	60	1	60	1
Totals		3,637	21	110,300	233	113,937	254

Table 3. State Park acreage treated - 1990 - Option I.

Park	County	Forest District	Bt		DFB		Park Total	
			Acres	Blocks	Acres	Blocks	Acres	Blocks
Archbald Pothole	Lackawanna	11	26	1	-	-	26	1
Beltzville	Carbon	18	156	1	-	-	156	1
Black Moshannon	Centre	5	350	3	-	-	350	3
Blue Knob	Bedford	2	-	-	1,000	1	1,000	1
Clear Creek	Jefferson	8	320	1	-	-	320	1
Colonel Denning	Cumberland	1	125	1	-	-	125	1
Colton Point	Tioga	16	-	-	75	1	75	1
Frances Slocum	Luzerne	20	200	3	-	-	200	3
Hickory Run	Carbon	18	750	3	-	-	750	3
Hyner View	Clinton	10	-	-	40	1	40	1
Jacobsburg	Northampton	19	405	2	-	-	405	2
Jennings EEC	Butler	8	212	1	-	-	212	1
Kettle Creek	Clinton	10	41	2	-	-	41	2
Keystone	Westmoreland	4	260	1	-	-	260	1
Kooser	Somerset	4	120	1	-	-	120	1
Laurel Hill	Somerset	4	577	2	440	3	1,017	5
Laurel Ridge	Fayette	4	-	-	20	1	152	6
	Somerset		-	-	132	5		
Leonard Harrison	Tioga	16	-	-	100	1	100	1
Laurel Mountain	Westmoreland	4	-	-	154	1	160	2
	Somerset		-	-	6	1		
Laurel Summit	Somerset	4	-	-	25	1	35	2
	Westmoreland		-	-	10	1		
Linn Run	Westmoreland	4	97	3	-	-	97	3
Little Pine	Lycoming	12	303	3	-	-	303	3
Locust Lake	Schuylkill	18	-	-	400	1	400	1
Nockamixon	Bucks	17	200	3	-	-	200	3
Ohiopyle	Fayette	4	255	1	1,425	5	1,680	6
Oil Creek	Venango	14	285	2	-	-	285	2
Ole Bull	Potter	15	94	1	-	-	94	1
Parker Dam	Clearfield	9	250	2	-	-	250	2
Pine Grove Furnace	Cumberland	1	110	2	85	4	195	6
Poe Valley	Centre	5	61	1	-	-	61	1
Promised Land	Pike	19	794	3	-	-	794	3
Pymatuning	Crawford	14	14	1	-	-	14	1
Ricketts Glen	Luzerne	20	535	2	-	-	535	2
Sinnemahoning	Cameron	13	100	6	-	-	106	7
	Potter		6	1	-	-		
Sizerville	Cameron	13	42	2	-	-	150	4
	Potter		108	2	-	-		
Trough Creek	Huntingdon	5	58	2	-	-	58	2
Tuscarora	Schuylkill	18	-	-	100	1	100	1
Yellow Creek	Indiana	6	285	3	-	-	285	3
Totals			7,139	62	4,012	28	11,151	90



Table 4. Federal acreage treated - 1990 - Option I.

Property	Agency*	County	Forest District	Bt		DFB		Property Total	
				Acres	Blocks	Acres	Blocks	Acres	Blocks
Conemaugh	ACOE (P)	Indiana	6	150	3	-	-	150	3
Cowanesque Dam	ACOE (B)	Tioga	16	102	1	-	-	102	1
Crooked Creek	ACOE (P)	Armstrong	8	324	6	-	-	324	6
Loyalhanna	ACOE (P)	Westmoreland	4	42	3	-	-	42	3
Mahoning Creek	ACOE (P)	Armstrong	8	62	1	-	-	62	1
Minersville	BOP	Schuylkill	18	-	-	127	1	127	1
Raystown	ACOE (B)	Huntingdon	5	80	1	-	-	80	1
Youghiogheny	ACOE (P)	Fayette Somerset	4	67 97	4 2	- -	- -	164	6
Totals				924	21	127	1	1,051	22

\*ACOE (B) = U. S. Army Corps of Engineers (Baltimore)

ACOE (P) = U. S. Army Corps of Engineers (Pittsburgh)

BOP = Federal Bureau of Prisons

Table 2. Other Assets Listed: 1990 Operation 1.

Property	Agency	County	Project Number	Ht			Property Total		
				Acres	Blacks	Whites	Acres	Blacks	Whites
Bobby Run	PRR	Westmoreland	3	100	1		100		
County Park	WR	Washington	2			1	20	1	
Park Farm	PRR	York	13			1	100		
Somerset Reserve Center	PRR	York	2	20	1			20	1
Total				100	1		100	1	

PRR = Pennsylvania Department of Agriculture  
 WR = Pennsylvania Forest and Waters Commission  
 WR = Washington County Government

Table 6. Acreage\* treated - 1990 - Option II.

County	Cooperator	Forest District	Bt		DFB		Cooperator Total	
			Acres	Blocks	Acres	Blocks	Acres	Blocks
Allegheny	County	4	1,048	25	1,697	18	2,745	43
Berks	County	17	4,279	81	-	-	4,279	81
Blair	County	6	6,208	34	-	-	6,208	34
Bucks	County	17	10,375	81	-	-	10,375	81
Butler	County	8	878	35	-	-	878	35
Cambria	County	6	2,993	64	-	-	2,993	64
Carbon	County	18	23,938	107	-	-	23,938	107
	Bethlehem Water Authority	18	505	1	-	-	505	1
Centre	County	5	5,425	87	-	-	5,425	87
Chester	Charlestown Township	17	350	3	-	-	350	3
	South Coventry Township	17	1,080	2	-	-	1,080	2
	Uwchlan Township	17	121	2	-	-	121	2
	West Vincent Township	17	21	1	-	-	21	1
	West Whiteland Township	17	35	2	-	-	35	2
Crawford	County	14	678	3	-	-	678	3
Lackawanna	County	11	6,430	42	-	-	6,430	42
Lancaster	Brecknock Township	17	166	5	-	-	166	5
	Colerain Township	17	113	3	-	-	113	3
	Conestoga Township	17	51	2	-	-	51	2
	East Drumore Township	17	238	6	-	-	238	6
	Eden Township	17	326	4	-	-	326	4
	Martic Township	17	909	13	-	-	909	13
	Paradise Township	17	242	1	-	-	242	1
	Providence Township	17	595	13	-	-	595	13
Lehigh	County	18	3,685	37	-	-	3,685	37
Luzerne	County	20	17,673	130	-	-	17,673	130
Lycoming	County	12	2,429	108	-	-	2,429	108
Mercer	County	8	475	14	-	-	475	14
Monroe	Bethlehem Water Authority	19	176	1	-	-	176	1
	Delaware Water Gap Borough	19	314	1	-	-	314	1
Montgomery	Abington Township	17	87	1	-	-	87	1
	Cheltenham Township	17	77	1	-	-	77	1
	Horsham Township	17	28	2	-	-	28	2
	Lower Frederick Township	17	400	5	-	-	400	5
	New Hanover Township	17	283	7	-	-	283	7
	Salford Township	17	113	3	-	-	113	3
	Springfield Township	17	60	1	-	-	60	1
	Upper Dublin Township	17	122	1	-	-	122	1
	Upper Frederick Township	17	291	3	-	-	291	3
	Upper Moreland Township	17	259	2	-	-	259	2
Northampton	Lehigh Township	19	1,585	15	-	-	1,585	15
	Moore Township	19	2,430	19	-	-	2,430	19
	Upper Mount Bethel Township	19	1,000	10	-	-	1,000	10
Northumberland	County	20	2,391	63	-	-	2,391	63
Pike	County	19	19,511	16	-	-	19,511	16
Schuylkill	County	18	17,815	174	-	-	17,815	174
Somerset	Addison Borough	4	115	1	-	-	115	1
	Boswell Borough	4	276	1	-	-	276	1
	Confluence Borough	4	90	1	-	-	90	1
	Indian Lake Borough	4	1,102	1	-	-	1,102	1
	Windber Borough	4	31	1	-	-	31	1
Venango	County	14	2,020	1	-	-	2,020	1
Wayne	County	11	10,835	63	-	-	10,835	63
York	County	1	1,478	18	-	-	1,478	18
Totals			154,155	1,318	1,697	18	155,852	1,336

\*All acreage was in the "Private Residential" ownership category, with the exception of four Bt and all DFB acres in Allegheny County and all Bethlehem Water Authority (Carbon and Monroe Counties) Bt acres which were in the "Other" category.

Table 7. Summary by county and ownership of acreage treated - 1990 - Options I and II.

County	Ownership				
	Private	State Forest	State Park	Federal	Other
Adams	-	476	-	-	-
Allegheny	4,729	-	-	-	1,701
Armstrong	992	-	-	386	-
Bedford	1,237	1,927	1,000	-	-
Berks	6,398	380	-	-	-
Blair	8,274	-	-	-	-
Bucks	11,967	-	200	-	-
Butler	1,148	-	212	-	-
Cambria	4,103	-	-	-	-
Cameron	310	4,260	142	-	-
Carbon	32,405	-	906	-	505
Centre	7,212	10,687	411	-	-
Chester	2,628	-	-	-	-
Clarion	2,670	-	-	-	-
Clearfield	2,169	28,164	250	-	-
Clinton	542	13,003	81	-	-
Columbia	2,039	60	-	-	-
Crawford	1,113	-	14	-	-
Cumberland	440	778	320	-	-
Elk	319	1,533	-	-	-
Fayette	-	7,144	1,700	67	-
Forest	606	-	-	-	-
Franklin	688	1,387	-	-	-
Fulton	399	593	-	-	-
Huntingdon	-	4,125	58	80	-
Indiana	1,758	-	285	150	-
Jefferson	1,430	115	320	-	-
Juniata	102	-	-	-	-
Lackawanna	8,514	492	26	-	-
Lancaster	4,900	-	-	-	-
Lebanon	164	-	-	-	-
Lehigh	3,685	-	-	-	-
Luzerne	24,254	-	735	-	-
Lycoming	3,531	2,500	303	-	-
Mercer	629	-	-	-	-
Monroe	26,277	139	-	-	176
Montgomery	2,904	-	-	-	-
Montour	456	-	-	-	-
Northampton	7,615	-	405	-	-
Northumberland	3,115	-	-	-	-
Perry	23	7,834	-	-	-
Pike	32,553	2,661	794	-	-
Potter	-	3,505	208	-	-
Schuylkill	22,774	820	500	127	-
Snyder	114	-	-	-	-
Somerset	4,258	9,772	1,300	97	28
Tioga	-	4,700	175	102	-
Union	155	2,700	-	-	-
Venango	5,731	287	285	-	301
Washington	106	-	-	-	40
Wayne	14,298	-	-	-	-
Westmoreland	-	3,895	521	42	105
Wyoming	359	-	-	-	-
York	2,083	-	-	-	-
Totals	264,176	113,937	11,151	1,051	2,856

393,171

Table 8. Summary by ownership and insecticide of acreage treated - 1990 -  
Option I, Option II, and Options I and II.

Ownership (Option I)	Bt		DFB		Total	
	Acres	Blocks	Acres	Blocks	Acres	Blocks
Private	109,168	1,021	1,538	7	110,706	1,028
State Forest	3,637	21	110,300	233	113,937	254
State Parks	7,139	62	4,012	28	11,151	90
Federal	924	21	127	1	1,051	22
Other	133	2	341	4	474	6
Totals	121,001	1,127	116,318	273	237,319	1,400
(Option II)						
Private	153,470	1,315	-	-	153,470	1,315
State Forest	-	-	-	-	-	-
State Parks	-	-	-	-	-	-
Federal	-	-	-	-	-	-
Other	685	3	1,697	18	2,382	21
Totals	154,155	1,318	1,697	18	155,852	1,336
(Options I and II)						
Private	262,638	2,336	1,538	7	264,176	2,343
State Forest	3,637	21	110,300	233	113,937	254
State Parks	7,139	62	4,012	28	11,151	90
Federal	924	21	127	1	1,051	22
Other	818	5	2,038	22	2,856	27
Totals	275,156	2,445	118,015	291	393,171	2,736

Table 9. Summary of project costs - 1990 - Options I and II.

DER

Expenses

Option I Application/Insecticide Contracts . . . . .	\$1,846,092
Option II Cost Sharing . . . . .	1,870,224
Overall Operating Costs . . . . .	<u>1,800,235</u>
Total Expenses . . . . .	\$5,516,551

Credits

Federal Cost Sharing . . . . .	(\$3,263,446)
Option I County Cost Sharing . . . . .	(428,036)
Option I Federal and Other Cooperators' Assessment . . . . .	<u>(20,362)</u>
Total Credits . . . . .	(\$3,711,844)
Net Cost . . . . .	\$1,804,707

Cooperator

Expenses

Option II Application/Insecticide Contracts . . . . .	\$1,936,796
Option I Cost Sharing . . . . .	428,036
Overall Operating Costs . . . . .	<u>1,314,565</u>
Total Expenses . . . . .	\$3,679,397

Credits

Option II DER Cost Sharing - Total Credit . . . . .	(\$1,870,224)
Net Cost . . . . .	\$1,809,173

Federal

Expenses

State Cost Sharing - Net Cost . . . . .	\$3,263,446
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Overall

DER	- \$1,804,707 (26.2%)
Cooperator	- 1,809,173 (26.3%)
Federal	- <u>3,263,446</u> (47.5%)
Total	- \$6,877,326 (100.0%)

Table 10. Application and insecticide contract costs - 1990 - Option I.

	Contract Number						Average or Total
	90-1	90-2	90-3	90-4	90-5	90-6	
Bid Price:							
Bt	\$8.43	\$10.25	\$11.23	\$8.63	\$8.70	\$7.36	\$8.31
DFB	6.11	6.50	9.19	6.31	6.38	-	7.03
Acres Treated:							
Bt	15,076	8,025	3,313	15,576	33,407	45,604	121,001
DFB	42,364	10,679	31,615	29,773	1,887	-	116,318
Extra Material*:							
Bt	828	3	12	35	317	1,318	2,513
DFB	34	0	0	2	0	-	36
Actual Cost/Acre:							
Bt	\$8.89	\$10.25	\$11.27	\$8.65	\$8.78	\$7.57	\$8.49
DFB	6.11	6.50	9.19	6.31	6.38	-	7.04
Contract Costs:							
Bt	\$134,071	\$ 82,287	\$ 37,340	\$134,723	\$293,399	\$345,346	\$1,027,166
DFB	259,052	69,414	290,542	187,880	12,039	-	818,927
Totals	\$393,123	\$151,701	\$327,882	\$322,603	\$305,438	\$345,346	\$1,846,093

\*Expressed as acre equivalents.

Table 11. Daily spraying progress by contract - 1990 - Option I.

Date	Acres Treated by Contract							Project Cumulation	
	90-1	90-2	90-3	90-4	90-5	90-6	All	Acres	Percent
5/6	-	-	2,377	-	-	-	2,377	2,377	1.0
5/7	3,660	-	3,130	-	3,302	-	10,092	12,469	5.3
5/8	4,558	828	2,772	-	2,799	1,034	11,991	24,460	10.3
5/9	7,096	-	696	2,795	2,467	1,307	14,361	38,821	16.4
5/10				NO SPRAYING - RAIN					
5/11				NO SPRAYING - RAIN					
5/12	3,952	1,694	4,418	2,368	2,731	2,029	17,192	56,013	23.6
5/13				NO SPRAYING - RAIN					
5/14	3,395	5,525	6,490	2,239	2,955	1,718	22,322	78,335	33.0
5/15	4,788	-	2,547	2,421	-	1,026	10,782	89,117	37.6
5/16				NO SPRAYING - RAIN					
5/17				NO SPRAYING - RAIN					
5/18	-	-	95	-	-	1,054	1,149	90,266	38.0
5/19	4,632	773	1,656	2,027	2,698	2,610	14,396	104,662	44.1
5/20	-	1,350	1,140	-	-	-	2,490	107,152	45.2
5/21	3,270	-	3,642	-	-	-	6,912	114,064	48.1
5/22	5,745	2,291	1,793	2,241	3,922	4,368	20,360	134,424	56.6
5/23	8,408	4,133	2,194	2,710	5,969	6,601	30,015	164,439	69.3
5/24	7,936	2,110	1,978	5,332	4,438	8,104	29,898	194,337	81.9
5/25	-	-	-	2,212	4,013	10,927	17,152	211,489	89.1
5/26				NO SPRAYING - RAIN					
5/27	-	-	-	764	-	-	764	212,253	89.4
5/28	-	-	-	-	-	4,826	4,826	217,079	91.5
5/29				NO SPRAYING - RAIN					
5/30	-	-	-	1,102	-	-	1,102	218,181	91.9
5/31	-	-	-	16,405	-	-	16,405	234,586	98.8
6/1	-	-	-	1,754	-	-	1,754	236,340	99.6
6/2	-	-	-	979	-	-	979	237,319	100.0
Totals	57,440	18,704	34,928	45,349	35,294	45,604	237,319		

Table 12. Summary of Option II contracts, costs, and insecticides - 1990.

County	Cooperator	Contractor	Price/ Acre	Insecticide		Acres	Cooperator	
				Insecticide	Rate/ Acre		Cost	DER Share
Allegheny	County	AgRotors	\$12.92	Dipel 8AF	21 BIU	1,048	\$ 13,540.16	\$ 12,576
	County	AgRotors	10.58	Dimilin 25W	2 oz	1,697	17,954.26	20,364
		Altair	13.75	Dipel 8AF	16 BIU	2,230	30,662.50	26,760
		Altair	13.75	Foray 48B	16 BIU	2,049	28,173.75	24,588
		Aero Tech	11.75	Foray 48B	24 BIU	6,208	72,944.00	74,496
Bucks	County	AgRotors	19.60	Dipel 8AF	16 BIU	10,375	203,350.00	124,500
Butler	County	Bob Ruhe	14.90	Dipel 8AF	16 BIU	878	13,082.20	10,536
Cambria	County	Altair	12.50	Dipel 8AF	20 BIU	2,993	37,412.50	35,916
Carbon	County	Bob Ruhe	9.89	Foray 48B	16 BIU	23,938	236,746.82	287,256
	Bethlehem Water Authority	Aero Tech	8.48	Dipel 8AF	16 BIU	505	4,282.40	6,060
		Appalachian	15.80	Foray 48B	20 BIU	5,425	85,715.00	65,100
		AgRotors	18.10	Dipel 8AF	16 BIU	350	6,335.00	4,200
		AgRotors	18.10	Dipel 8AF	16 BIU	1,080	19,548.00	12,960
Centre	County	AgRotors	18.10	Dipel 8AF	16 BIU	121	2,190.10	1,452
	Charlestown Township	AgRotors	18.10	Dipel 8AF	16 BIU	21	380.10	252
		AgRotors	18.10	Dipel 8AF	16 BIU	35	633.50	420
		Aero Tech	16.00	Dipel 8AF	16 BIU	678	10,848.00	8,136
		Aero Tech	9.60	Foray 48B	20 BIU	6,430	61,728.00	77,160
Crawford	Brecknock Township	K & K Aircraft	19.10	Foray 48B	16 BIU	166	3,170.60	1,992
	Colerain Township	AgRotors	22.60	Dipel 8AF	16 BIU	113	2,553.80	1,356
	Conestoga Township	AgRotors	22.00	Dipel 8AF	16 BIU	51	1,122.00	612
	East Drumore Township	AgRotors	24.60	Dipel 8AF	16 BIU	238	5,854.80	2,856
	Eden Township	AgRotors	22.60	Dipel 8AF	16 BIU	326	7,367.60	3,912
Lackawanna	Martic Township	AgRotors	14.10	Dipel 8AF	16 BIU	909	12,816.90	10,908
	Paradise Township	AgRotors	22.60	Dipel 8AF	16 BIU	242	5,469.20	2,904
	Providence Township	AgRotors	22.60	Dipel 8AF	16 BIU	595	13,447.00	7,140
	County	Cordoba	13.79	Dipel 8AF	16 BIU	3,685	50,816.15	44,220
	County	K & K Aircraft	9.86	Dipel 8AF	16 BIU	17,673	174,255.78	212,076
Lancaster	County	Helicopter Applicators	14.00	Dipel 8AF	16 BIU	2,429	34,006.00	29,148
	County	Altair	14.00	Foray 48B	16 BIU	475	6,650.00	5,700
	Delaware Water Gap Borough	AgRotors	18.50	Dipel 8AF	16 BIU	314	5,809.00	3,768
	Bethlehem Water Authority	AgRotors	8.48	Dipel 8AF	16 BIU	176	1,492.48	2,112

Table 12. Summary of Option II contracts, costs, and insecticides - 1990 (continued).

County	Cooperator	Contractor	Price/ Acre	Insecticide		Acres	Cooperator Cost	DER Share
				Type	Rate/ Acre			
Montgomery	Abington Township	Evergreen	25.97	Dipel 8AF	16 BIU	87	2,259.39	1,044
	Cheltenham Township	Evergreen	25.97	Dipel 8AF	16 BIU	77	1,999.69	924
	Horsham Township	Evergreen	25.97	Dipel 8AF	16 BIU	28	727.16	336
	Lower Frederick Township	Evergreen	25.97	Dipel 8AF	16 BIU	400	10,388.00	4,800
	New Hanover Township	Evergreen	25.97	Dipel 8AF	16 BIU	283	7,349.51	3,396
	Salford Township	Evergreen	25.97	Dipel 8AF	16 BIU	113	2,934.61	1,356
	Springfield Township	Evergreen	25.97	Dipel 8AF	16 BIU	60	1,558.20	720
	Upper Dublin Township	Evergreen	25.97	Dipel 8AF	16 BIU	122	3,168.34	1,464
	Upper Frederick Township	Evergreen	25.97	Dipel 8AF	16 BIU	291	7,557.27	3,492
	Upper Moreland Township	Evergreen	25.97	Dipel 8AF	16 BIU	259	6,726.23	3,108
Northampton	Lehigh Township	Cordoba	13.79	Dipel 8AF	16 BIU	1,585	21,857.15	19,020
	Moore Township	Cordoba	13.79	Dipel 8AF	16 BIU	2,430	33,509.70	29,160
	Upper Mount Bethel Township	K & K Aircraft	17.61	Dipel 8AF	16 BIU	1,000	17,610.00	12,000
	County	AgRotors	16.53	Dipel 8AF	16 BIU	2,391	39,523.23	28,692
Northumberland Pike	County	Aero Tech	8.35	Dipel 8AF	16 BIU	1,380	11,523.00	16,560
		Aero Tech	8.99	Dipel 8AF	16 BIU	4,938	44,392.62	59,256
		Aero Tech	9.48	Dipel 8AF	16 BIU	2,316	21,955.68	27,792
		AgRotors	10.42	Dipel 8AF	16 BIU	5,426	56,538.92	65,112
Schuylkill Somerset	County	AgRotors	13.80	Dipel 8AF	16 BIU	5,451	75,223.80	65,412
	Addison Borough	Cordoba	11.87	Dipel 8AF	16 BIU	17,815	211,464.05	213,780
	Boswell Borough	AgRotors	20.94	Dipel 8AF	16 BIU	115	2,408.10	1,380
	Confluence Borough	AgRotors	19.14	Dipel 8AF	16 BIU	276	5,282.64	3,312
Venango	Indian Lake Borough	AgRotors	23.74	Dipel 8AF	16 BIU	90	2,136.60	1,080
	Windber Borough	AgRotors	13.84	Dipel 8AF	16 BIU	1,102	15,251.68	13,224
	County	AgRotors	28.64	Dipel 8AF	16 BIU	31	887.84	372
		Altair	10.25	Foray 48B	16 BIU	520	5,330.00	6,240
Wayne York	County	Altair	10.25	Condor OF	16 BIU	1,500	15,375.00	18,000
		Aero Tech	11.75	Dipel 8AF	20 BIU	10,835	127,311.25	130,020
	County	Aero Tech	9.60	Foray 48B	20 BIU	1,478	14,188.80	17,736
Totals						155,852	\$1,936,796.06	\$1,870,224

Table 13. Insecticide used - 1990 - Option I and Option II.

Insecticide	Formulation	Rate/Acre	Volume/ Acre (Oz)	Diluted or Undiluted*	Acres		
					Option I	Option II	Total
Bt	Condor OF	24 BIU	128	D	6,280	1,500	7,780
		Dipel 8AF	16 BIU	D	98,184	91,090	189,274
		16 BIU	96	D	2,596	0	2,596
		20 BIU	128	D	0	13,828	13,828
		21 BIU	96	D	0	1,048	1,048
	Foray 48B	16 BIU	128	D	2,807	27,148	29,955
		20 BIU	128	D	0	13,333	13,333
		20 BIU	53	U	6,622	0	6,622
		24 BIU	128	D	3,109	6,208	9,317
		30 BIU	80	U	1,403	0	1,403
DFB	Dimilin 25W	.004 oz AI	128	D	100	0	100
		.04 oz AI	128	D	100	0	100
		.4 oz AI	128	D	105,439	0	105,439
		.4 oz AI	96	D	10,679	0	10,679
		.5 oz AI	128	D	0	1,697	1,697
					237,319	155,852	393,171

\*Water used as carrier with all diluted applications; no stickers were added to any application.

Table 14. Spray aircraft utilized - 1990 - Option I.

Aircraft		Contractor	Pilot	Contract
Model	Registration Number			
Ag Truck 188	N2200F	Altair	F. Staunch	5
	N70482	Altair	G. Glenn	5
Air Tractor 400	N23720	Altair	R. Everett	1
	N501JK	Altair	R. Rawlings	1
Air Tractor 502	N1002L	Altair	D. Willis	1, 4*
	N1005S	Altair	J. Beadle	5, 4*
			P. Rouleau	4*
	N1006Y	Altair	J. Morgan	5, 4*
			P. DeMaeyer	4*
	N502JP	Altair	T. Lefebvre	1, 4*
Bell Soloy	N121CD	Helicopter Applicators	M. Haworth	3
	N7936S	Helicopter Applicators	J. Klocker	3
Bull Thrush	N2239S	Altair	W. Ketch	4
	N2239X	Altair	P. Anderson	4
DC-3	N56KS	K & K Aircraft	K. Stoltzfus	6
Grumman Ag-Cat	N7155J	Altair	L. Myelle	4
	N7155P	Altair	R. Wallace	4
Sikorsky S-55	N37799	Helicopter Applicators	D. Webb	3
Turbo Thrush	N7155S	Altair	W. Hamilton	2, 4*
	N7155W	Altair	P. DeMaeyer	2, 4*
Twin Beech	N1002C	K & K Aircraft	B. Senger	6
	N1400E	K & K Aircraft	J. Ethell	6
Twin Beech Turbine	N38L	K & K Aircraft	R. Kiser	6

\*Contract restrictions prevent the designation of the same aircraft for two or more contracts by the same contractor. These aircraft were permitted to move to the second contract only after their obligation to the initial contract had been met.

Table 15. Spray aircraft calibration - 1990 - Option 1.

Aircraft		Nozzles			Boom Length (Feet)	Air Speed (mph)	Lane (Feet)	Flow Rate (gpm)	
Model	Registration Number	Tip	Number	Angle <sup>o</sup>	Material			Desired	Set
Ag Truck 188	N2200F N70482	D4-45	46	45	SS*	120	75	18.2	18.0
		D4-45	47	45	SS	115	75	17.4	17.0
Air Tractor 400	N23720 N501JK	D8-45	40	90	SS	150	100	30.3	30.3
		D8-45	39	90	SS	150	100	30.3	30.0
Air Tractor 502	N1002L N1005S N1006Y N502JP	D8-45	32	45	SS	150	100	30.3	30.0
		D6-45	49	45	SS	140	100	28.2	29.0
		D6-45	49	45	SS	140	100	28.2	29.0
		D8-45	35	90	SS	150	100	30.3	31.0
Bell Soloy	N121CD N7936S	8003	45	45	SS	70	100	14.1	13.7
		8003	48	45	SS	65	100	13.1	12.8
Bull Thrush	N2239S N2239X	D6-45	47	90	SS	135	100	27.3	27.0
		D6-45	47	90	SS	135	100	27.3	27.0
DC-3	N56KS	8020	50	45	SS	160	300	97.0	97.0
Grumman Ag-Cat	N7155J N7155P	D4-45	52	45	SS	100	100	20.2	20.5
		D4-45	52	45	SS	100	100	20.2	20.0
Sikorsky S-55	N37799	8004	53	45	SS	70	125	17.7	17.2
Turbo Thrush	N7155S N7155W	AU5000	6	-	-	135	100	11.4	11.4
		AU5000	6	-	-	135	100	11.4	11.4
Twin Beech	N1002C N1400E	8020	16	45	SS	160	100	32.3	32.0
		8020	16	45	SS	160	100	32.3	32.3
Twin Beech Turbine	N38L	8020	16	45	SS	160	100	32.0	32.0

\*SS = stainless steel

Table 16. Individual spray aircraft production data - 1990 - Option I.

Volume/ Acre (Ounce)	Aircraft		Pilot	Production							
	Model	Reg. No.		Flight Time (Hours)	Blocks*	Loads	Gallons Sprayed	Acres Sprayed	Average Block Size**	Gallons/ Load	Acres/ Hour
53.3	Turbo Thrush	N7155S	W. Hamilton	17.3	57	12	1,379	3,313	58	115	192
	Turbo Thrush	N7155W	P. DeMaeyer	17.3	57	12	1,379	3,313	58	115	192
80.0	Turbo Thrush	N7155S	W. Hamilton	1.4	2	3	438	702	351	146	501
	Turbo Thrush	N7155W	P. DeMaeyer	1.4	2	3	438	702	351	146	501
96.0	Turbo Thrush	N7155S	W. Hamilton	24.0	64	25	4,978	6,637	104	199	277
	Turbo Thrush	N7155W	P. DeMaeyer	24.0	64	25	4,978	6,637	104	199	277
128.0	Ag Truck 188	N2200F	F. Staunch	46.1	113	50	6,163	6,163	55	124	134
	Ag Truck 188	N70482	G. Glehn	50.2	118	54	6,920	6,920	59	128	139
	Air Tractor 400	N23720	R. Everett	36.4	89	45	13,429	13,429	151	298	369
	Air Tractor 400	N501JK	R. Rawlings	35.9	111	44	12,987	12,987	117	295	362
	Air Tractor 502	N1002L	D. Willis	50.5	156	46	15,747	15,747	101	342	312
	Air Tractor 502	N1005S	J. Beadle	56.6	171	43	15,062	15,062	88	350	266
	Air Tractor 502	N1006Y	J. Morgan	59.6	182	45	16,010	16,010	88	356	269
	Air Tractor 502	N502JP	T. Lefebvre	50.9	141	51	17,257	17,257	122	338	339
	Bell Soloy	N121CD	M. Haworth	31.1	43	105	10,691	10,691	249	102	344
	Bell Soloy	N7936S	J. Klocker	38.4	28	132	12,021	12,021	429	91	313
	Bull Thrush	N2239S	W. Ketch	35.1	75	35	10,758	10,758	143	307	307
	Bull Thrush	N2239X	P. Anderson	41.0	109	40	12,167	12,167	112	304	297
	DC-3	N56KS	K. Stoltzfus	26.0	29	26	24,490	24,490	844	942	942
	Grunman Ag-Cat	N7155J	L. Myelle	42.5	63	42	6,198	6,198	98	146	148
	Grunman Ag-Cat	N7155P	R. Wallace	27.6	18	19	3,736	3,736	208	197	135
	Sikorsky S-55	N37799	D. Webb	28.9	46	81	12,228	12,228	266	151	423
	Twin Beech	N1002C	B. Senger	58.7	90	46	14,851	14,851	165	323	253
	Twin Beech	N1400E	J. Ethell	25.3	38	19	5,979	5,979	157	315	236
	Twin Beech Turbine	N38L	R. Kiser	5.3	9	5	1,602	1,602	178	320	302

\*When a block was sprayed in tandem, it was counted as a block treated for each of the aircraft. This resulted in a greater number of blocks being recorded than were actually in the project (1,400).

\*\*When a block was sprayed in tandem, the acreage within the block was assigned proportionately to the appropriate aircraft. This resulted in a smaller effective average block size for aircraft used extensively in that manner.

Table 17. Production data by aircraft model - 1990 - Option I.

Aircraft Model	Percent of Project	Production							
		Flight Time (Hours)	Blocks*	Loads	Gallons Sprayed	Acres Sprayed	Average Block Size**	Gallons/ Load	Acres/ Hour
Ag Truck 188	5.5	96.3	231	104	13,084	13,084	57	126	136
Air Tractor 400	11.0	72.3	200	89	26,416	26,416	132	297	365
Air Tractor 502	26.7	217.6	650	185	64,076	64,076	99	346	294
Bell Soloy	9.5	69.5	71	237	22,712	22,712	320	396	327
Bull Thrush	9.6	76.1	184	75	22,927	22,927	125	307	301
Douglas DC-3	10.2	26.0	29	26	24,490	24,490	844	942	942
Grumman Ag-Cat	4.1	70.1	81	61	9,934	9,934	123	163	142
Sikorsky S-55	5.1	28.9	46	81	12,228	12,228	266	151	423
Turbo Thrush	8.9	85.4	248	80	13,590	21,304	87	170	249
Twin Beech	8.7	84.0	128	65	20,830	20,830	163	320	248
Twin Beech Turbine	.7	5.3	9	5	1,602	1,602	178	320	302
Totals		831.5	1,877	1,008	231,889	239,603	218	230	288

\*When a block was sprayed in tandem, it was counted as a block treated for each of the aircraft. This resulted in a greater number of blocks being recorded than were actually in the project (1,400).

\*\*When a block was sprayed in tandem, the acreage within the block was assigned proportionately to the appropriate aircraft. This resulted in a smaller effective average block size for aircraft used extensively in that manner.

Table 18. Observation aircraft used - 1990 - Option I.

Contract	District	Aircraft		Pilot(s)	Observer(s)	Cost/Hour	Hours Flown	Cost
		Model	Registration Number					
1	8	Cessna 172	N17676Q	D. Sheets	M. Bodamer	\$ 85.00	12.65	\$ 1,075.25
	9	Cessna 172	N86510	A. Sallade	A. Reinke	56.00	12.20	683.20
	13	None used.						
	14	Cessna 172	N19673	D. Kudlak/C. Sharrer	C. Thompson	65.00	9.60	624.00
		Cessna 172	N65003	T. Brugh	C. Thompson	65.00	4.50	292.50
2	11	None used.						
	12	None used.						
	15	Cessna 172	N7335H	A. Sallade	C. Brown	65.00	10.50	682.50
	16	Cessna 172	N80952	R. Johnston	W. Beacom	55.00	1.80	99.00
		Cessna 182	N8303S	R. Johnston	W. Beacom	65.00	6.36	413.40
3	3	Cessna 177	N30979	S. Snyder	G. Bell	140.00	6.80	952.00
	5	Cessna 172	N62350	L. Garbrick	R. Pawlowski	62.00	11.00	682.00
		Cessna 172	N736CN	L. Garbrick	R. Pawlowski	62.00	7.00	434.00
	7	Cessna 172	N62350	L. Garbrick	L. Johnson	62.00	9.35	579.70
	10	Cessna 172	N736CN	L. Garbrick	J. Prowant/J. Fiedor	65.00	30.00	1,950.00
4	1	None used.						
	2	None used.						
	4	None used.						
	6	Cessna 172	N65623	P. Rhoades	G. Scott	49.00	11.50	563.50
5	17	None used.						
	18	Cessna 172	N54910	S. Inhoffer/J. Conahan	L. Newswanger	59.99	46.70	2,801.53
	20	Cessna 182D	N8757X	F. Pavelko	D. Hartwigsen	75.00	10.70	802.50
6	19	None used.						
Average/Total							190.66	\$12,635.08

Table 19. Spray aircraft utilized - 1990 - Option II.

Contractor	Aircraft		Pilot
	Model	Registration Number	
Aero Tech	Air Tractor 400	N23649	Jim Uselton
	Air Tractor 400	N2369N	Ted Stallings
	Air Tractor 400	N3160Q	Danny Howland
	Air Tractor 400	N611CP	Carl Payne
AgRotors	Bell 204	N847MC	Victor Gray
	Bell 206	N206BX	David Bortscheller
	Bell 206	N206BY	Carl Mosegard
	Bell 206	N49718	Mike Smith
	Bell 206	N9907K	Dan Riley
	Bell 212	N8530B	Timothy Voss
	Hughes 500D	N1097J	Maurice Messersmith
	Hughes 500D	N5027P	Gary Dobler
Altair	Air Tractor 401	N23720	Ray Everitt
	Air Tractor 401	N501JK	Bob Rawlings
	Air Tractor 502	N1002L	Dwight Willis
	Air Tractor 502	N502JP	Tom Lefebvre
	Bull Thrush	N2239S	Wayne Ketch
	Bull Thrush	N2239X	Paul Anderson
	Bull Thrush	N7143J	Jim Seitz
	Grumman Ag-Cat	N7155J	Len Myelle
	Grumman Ag-Cat	N7155P	Bob Wallace
Appalachian	Bell 204	N9846F	Stephen Karschner
Bob Ruhe	Ag Husky	N21933	Don Recker
	Turbo Thrush	N4021G	Kent Miese
	Turbo Thrush	N8460V	Charles Moon
Cordoba	Ag Truck	N1992J	Jim Lackey
	Ag Truck	N2695J	John Cutts
	Ag Truck	N731ET	Carl Myers
Evergreen	Bell 206	N59612	Ronald Wolf
Helicopter Applicators	Bell Soloy	N122CD	Rick Farwell
K & K Aircraft	DC-3	N177H	Fred Coons
	Grumman Ag-Cat	N602U	Paul Duffy/Mike Hensel
	Grumman Ag-Cat	N913X	Mike Hensel
	Turbo Thrush	N4001T	Caleb Glick
	Twin Beech	N1002C	Bruce Senger
	Twin Beech	N1400E	Jeff Ethell
	Twin Beech	N38L	Richard Kiser



Table 20. Individual spray aircraft production data - 1990 - Option II.

Volume/ Acre (ounce)	Aircraft		Pilot	Production					Acres/ Hour
	Model	Reg. No.		Flight Time (Hours)	Blocks*	Loads	Gallons Sprayed	Acres Sprayed	
53.3	Air Tractor 400	N23649	J. Uselton	16.2	106	18	2,308	5,716	128
	Air Tractor 400	N3160Q	D. Howland	13.3	102	17	2,255	5,872	133
	Air Tractor 400	N611CP	C. Pane	13.3	106	14	2,304	5,706	165
128.0	Ag Huskey	N21933	D. Recker	23.2	57	24	2,802	2,802	117
	Ag Truck	N1992J	J. Lackey	23.0	45	49	4,984	4,984	102
	Ag Truck	N2695J	J. Cutts	81.6	144	74	13,207	13,207	178
	Ag Truck	N731ET	C. Myers	41.9	66	61	8,083	8,083	133
	Air Tractor 400	N23649	J. Uselton	17.0	49	22	6,576	6,576	299
	Air Tractor 400	N2369N	T. Stallings	2.1	10	3	531	531	177
	Air Tractor 400	N23720	R. Everitt	3.6	9	4	1,268	1,268	317
	Air Tractor 400	N3160Q	D. Howland	8.5	23	13	4,170	4,170	321
	Air Tractor 400	N501JK	R. Rawlings	3.4	6	4	1,227	1,227	307
	Air Tractor 400	N611CP	C. Pane	15.4	48	23	6,415	6,415	279
	Air Tractor 502	N1002L	D. Willis	7.7	42	5	1,582	1,582	316
	Air Tractor 502	N502JP	T. Lefebvre	12.8	45	7	2,145	2,145	306
	Bell 204	N847MC	V. Gray	5.0	5	7	1,614	1,614	231
	Bell 204	N9846F	S. Karschner	16.7	95	30	5,898	5,898	197
	Bell 206	N2068X	D. Bortscheller	48.0	131	198	18,626	18,626	388
	Bell 206	N2068Y	C. Mosegard	10.1	12	38	3,417	3,417	90
	Bell 206	N59612	R. Wolf	8.0	25	19	1,726	1,726	91
	Bell 206	N9907K	D. Riley	13.4	69	83	5,742	5,742	83
	Bell Soloy	N122CD	R. Farwell	15.6	101	28	2,429	2,429	87
	Bull Thrush	N2239S	W. Ketch	1.7	7	1	268	268	158
	Bull Thrush	N2239X	P. Anderson	1.0	1	1	250	250	250
	Bull Thrush	N7143J	J. Seitz	7.4	34	10	2,241	2,241	224
	DC-3	N177H	F. Coons	5.7	18	4	3,792	3,792	948
	Grunman Ag-Cat	N602U	M. Hensel	7.5	20	12	1,998	1,998	167
	Grunman Ag-Cat	N602U	P. Duffy	10.8	17	16	2,674	2,674	167
	Grunman Ag-Cat	N7155J	L. Myelle	1.5	2	2	70	70	35
	Grunman Ag-Cat	N7155P	R. Wallace	2.4	1	2	310	310	47
	Grunman Ag-Cat	N913X	M. Hensel	16.9	28	21	4,447	4,447	155
	Hughes 500	N1097J	M. Messersmith	6.8	25	11	1,097	1,097	212
	Hughes 500	N5027P	G. Dobler	8.3	34	14	1,294	1,294	100
	Twin Beech	N1002C	B. Senger	3.4	7	2	573	573	92
	Twin Beech	N1400E	J. Ethell	6.7	14	5	1,577	1,577	287
	Twin Beech	N38L	R. Kiser	2.2	4	2	670	670	315
	Thrush	N52R	G. Glick	14.9	41	14	3,169	3,169	335
	Turbo Thrush	N4021G	K. Miese	24.6	60	31	9,970	9,970	226
	Turbo Thrush	N8460V	C. Moon	23.7	39	36	12,101	12,101	322
									336

\*When a block was sprayed in tandem, it was counted as a block treated for each of the aircraft. This resulted in a greater number of blocks being recorded than were actually in the project (1,336).

\*\*When a block was sprayed in tandem, the acreage within the block was assigned proportionately to the appropriate aircraft. This resulted in a smaller effective average block size for aircraft used extensively in that manner.

Table 21. Production data by aircraft model - 1990 - Option II.

Aircraft Model	Percent of Project	Production							
		Flight Time (Hours)	Blocks*	Loads	Gallons Sprayed	Acres Sprayed	Average Block Size**	Gallons/ Load	Acres/ Hour
Ag Huskey	2	23.2	57	24	2,802	2,802	49	117	121
Ag Truck	17	146.5	255	184	26,274	26,274	103	143	179
Air Tractor 400	24	92.8	459	118	27,058	37,481	82	229	404
Air Tractor 502	2	20.5	87	12	3,727	3,727	43	311	182
Bell 204	5	21.7	100	37	7,512	7,512	75	203	346
Bell 206	19	79.5	237	338	29,511	29,511	125	87	371
Bell Soloy	2	15.6	101	28	2,429	2,429	24	87	156
Bull Thrush	2	10.1	42	12	2,759	2,759	66	230	273
DC-3	2	5.7	18	4	3,792	3,792	211	948	665
Grunman Ag-Cat	6	39.1	68	53	9,499	9,499	140	179	243
Hughes 500	2	15.1	59	25	2,391	2,391	41	96	158
Twin Beech	2	14.5	25	9	2,820	2,820	113	313	194
Thrush	2	14.9	41	14	3,169	3,169	77	226	213
Turbo Thrush	14	48.3	99	67	22,071	22,071	223	329	457

\*When a block was sprayed in tandem, it was counted as a block treated for each of the aircraft. This resulted in a greater number of blocks being recorded than were actually in the project (1,336).

\*\*When a block was sprayed in tandem, the acreage within the block was assigned proportionately to the appropriate aircraft. This resulted in a smaller effective average block size for aircraft used extensively in that manner.

Table 22. Pennsylvania gypsy moth defoliation - 1990.

County	Acres		Total
	Moderate	Heavy	
Allegheny	300	400	700
Armstrong	90,800	44,200	135,000
Beaver	1,100	500	1,600
Bedford	93,500	8,100	101,600
Berks	7,400	42,200	49,600
Blair	85,600	25,400	111,000
Bradford	12,800	40,700	53,500
Bucks	2,000	15,700	17,700
Butler	28,400	23,100	51,500
Cambria	8,700	32,300	41,000
Cameron	95,400	131,300	226,700
Carbon	5,700	136,600	142,300
Centre	28,700	180,900	209,600
Chester	900	1,100	2,000
Clarion	26,300	13,800	40,100
Clearfield	100,000	200,000	300,000
Clinton	7,800	241,900	249,700
Columbia	3,300	65,200	68,500
Crawford	400	200	600
Cumberland	800	100	900
Elk	176,200	79,400	255,500
Fayette	33,700	65,900	99,600
Franklin	1,000	200	1,200
Fulton	4,900	0	4,900
Huntingdon	12,800	200	13,000
Indiana	0	111,400	111,400
Jefferson	61,400	54,800	116,200
Juniata	1,500	0	1,500
Lackawanna	8,500	86,500	95,000
Lancaster	100	2,900	3,000
Lawrence	700	0	700
Lehigh	4,000	18,700	22,700
Luzerne	23,600	179,900	203,500
Lycoming	23,100	424,900	448,000
McKean	400	2,800	3,200
Mercer	9,700	4,100	13,800
Mifflin	2,400	600	3,000
Monroe	41,200	107,300	148,500
Montgomery	500	5,500	6,000
Montour	700	1,800	2,500
Northampton	19,100	16,300	35,400
Northumberland	14,800	21,400	36,200
Perry	3,800	3,200	7,000
Pike	65,000	112,200	177,200
Potter	17,800	17,100	34,900
Schuylkill	4,700	218,700	223,400
Snyder	200	0	200
Somerset	43,900	55,100	99,000
Sullivan	6,300	7,300	13,600
Susquehanna	11,700	4,500	16,200
Tioga	31,800	55,700	87,500
Union	3,200	50,300	53,500
Venango	47,700	38,000	85,700
Washington	0	100	100
Wayne	1,900	14,400	16,300
Westmoreland	37,100	37,100	74,200
Wyoming	35,200	5,300	40,500
57 Counties	1,350,500	3,007,300	4,357,700







National Steering Committees for Aerial Application of Pesticides  
Gypsy Moth and Other Eastern Defoliators

Summary of AIPM Activities - 1990

The Appalachian Integrated Pest Management (AIPM) Gypsy Moth Program supported numerous methods improvement and pilot/special projects in FY 90. These activities were conducted cooperatively with USDA Forest Service - FIDR and FPM; Agricultural Research Service, Animal and Plant Health Inspection Service; WV/VA Departments of Agriculture; and universities.

Several of the priorities identified by the members of the Gypsy Moth and Other Eastern Defoliators Committee at the annual meeting in Columbus, OH in 1989 were addressed:

Laboratory Tests

- 1 - Literature data base of Dimilin non-target effects (not human health) computerized, accessible by cooperators, and maintained by AIPM in Morgantown.  
ONGOING
- 2 - Funding provided to Dave Miller (U of CT) to evaluate meteorological parameters associated with deciduous forests as inputs into FSCBG.  
ONGOING

Field Tests

- 1 - Field test conducted to compare efficacy resulting from application of Bt (Foray 48B) using different types of atomizers. No significant differences among dosages (20 and 30 BIU/A) and atomizers (flat fan 8004, Micronair AU-5000, Twin Jet 8004) for foliage protection or population reduction. Control populations showed significant natural mortality.  
COMPLETE
- 2 - Efficacy of Gypchek when aerially applied at standard and two reduced dosages. The standard ( $5 \times 10''$  PIB/A applied twice) dose was not significantly different from the  $2.5 \times 10''$  PIB/A dose but both significantly different from the  $1.25 \times 10''$  dose.  
COMPLETE - see attached write-up

Demonstration Projects

- 1 - Multiple applications of Gypchek against high density (up to 22,000 EM/A) isolated populations of gypsy moth. Efficacy results excellent as only one new egg mass.  
COMPLETE

### Pilot Projects

- 1 - Compare efficacy of Dipel 6 AF and Foray 48B applied undiluted at 30 BIU/A. Uncorrected population reduction was approximately 70%.  
COMPLETE

### Equipment, Models and Technology Development

- 1 - Utility of FSCBG to predict canopy penetration by comparing deposition predictions to observed for eastern deciduous canopies.  
ONGOING

AIPM Activities (as of 11/90) - 1991

### Laboratory Tests

- 1 - Update and maintain Dimilin non-target database.
- 2 - Continue funding Miller (U of CT) to evaluate meteorological parameters associated with eastern deciduous forests as inputs into FSCBG.

### Field Tests

- 1 - Work cooperatively with NEFAAT and Bt companies to broaden application timing window for Bt to eastern deciduous forests for reduction of gypsy moth populations.
- 2 - Work cooperatively with FIDR - RWU - 4502 to evaluate efficacy of Gypchek across years to suppress low (30-80 EM/A) density gypsy moth populations.
- 3 - Develop for operational use a "ready to use" formulation of Gypchek.
- 4 - Evaluate aerial application of flake and bead formulations of racemic disparlure in terms of efficacy and pheromone persistence.

### Equipment, Models and Technology Development

- 1 - Continue funding Yendol (PSU) to evaluate observed vs predicted (FSCBG) canopy deposition for eastern deciduous canopies.

### Pilot Projects

- 1 - Continue funding studies to determine potential non-target effects of Bt on aquatic macroinvertebrates, canopy arthropods and food of endangered Virginia Big-eared Bat; Dimilin on terrestrial/aquatic salamanders, canopy arthropods, aquatic macroinvertebrates, and soil microflora and arthropods in closed watersheds; and gypsy moth defoliation on canopy arthropods.

## STATUS OF GYPSY MOTH NPV, GYPCHEK, IN USA

John Podgwaite<sup>1</sup>, Richard Reardon<sup>2</sup> and Harry Hubbard<sup>1</sup>

<sup>1</sup>Forest Insect and Disease Research, USDA Forest Service, Hamden, CT

<sup>2</sup>Northeastern Area, State & Private Forestry, USDA Forest Service, Morgantown, WV

In 1960, the USDA Forest Service began to explore the feasibility of developing *Bacillus thuringiensis* (*Bt*) and the gypsy moth nucleopolyhedrosis virus as alternatives to chemical insecticides for suppressing gypsy moth populations. By 1970, over 25 strains of *Bt* had been evaluated against the gypsy moth; and in 1978, the gypsy moth nucleopolyhedrosis virus product Gypchek was approved (Environmental Protection Agency) for registration by the U.S. Forest Service.

Since its registration and prior to 1987, various Gypchek formulations were aerially-applied at various dosages and rates, and in the evening and morning using various types of aircraft and nozzles. Efficacy results were often inconsistent (Podgwaite), due in part, to inadequate sunscreens in the formulations, and marginal application dosages. In 1987, an improved Gypchek formulation containing molasses and Orzan LS (a lignosulfonate) was field tested in Maryland with improved efficacy results (Webb et al., J. Econ. Entomol. 82:1695-1701, 1989). The formulation (Orzan LS-6% W/V, molasses - 12.5% V/V, and Rhoplex 2% V/V) has been maintained and when applied at 2 gal/A and  $5 \times 10^{11}$  PIB/A for each of two applications (3-days apart) is considered the standard. The necessity for 2 applications (3 days apart) at 2 gal/A/appl, the limited supply of product, and the increased demand has resulted in the initiation of a series of field studies designed to increase efficacy and reduce cost. In 1988, the standard formulation of Gypchek was applied using the same application parameters as in 1987 except against higher density gypsy moth populations (800-3,500 egg masses/A) in more mountainous terrain. These results were encouraging (ave net pop. reduction 94% and foliage protection 45% (Podgwaite in press). In 1989, the standard formulation was applied using 2 applications (3-days apart) at  $5 \times 10^{11}$  PIB/A per application and also using 1 application at  $1 \times 10^{12}$  PIB/A. The results were not encouraging for the use of one instead of two applications (8% and 40% net population reduction and 18% and 44% foliage protection, respectively). In 1990, the standard formulation was applied using 2 applications for each of three dosages:  $5 \times 10^{11}$  PIB/A,  $2.5 \times 10^{11}$ , and  $1.25 \times 10^{11}$ . The highest dosage provided uncorrected population reduction of 84% and foliage protection of 50% as compared to the other dosages (85% and 74%; and 46% and 47%, respectively).

Gypchek is presently being phased into commercial development using in vivo and in vitro systems. Also, additional strains (e.g. Abington) have been identified and the search is continuing for more virulent strains. Further, new and improved formulations of Gypchek are being researched and will be field-tested as they become available.

The current recommendation is to use the standard formulation of Gypchek applied twice 3-days apart, 2 gal/A and  $5 \times 10^{11}$  PIB/A per appl., against moderate to high density (300-5,000 EM/A) populations.

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LIST OF TANK MIXES AND ATOMIZERS EVALUATED IN WIND TUNNEL



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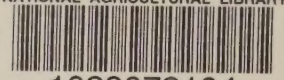
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